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ABSTRACT

This curriculum program for grades 7-12 was developed to increase awareness of the hazardous materials problem on local, state, national, and global levels. This curriculum material highlights an important science-technology-society issue and are applicable to the science, health, social studies, and language arts disciplines. Units include: (1) "Connections" (providing the common ground for the curriculum); (2) "Hazardous Materials in the Home"; (3) "Hazardous Materials in the School"; (4) "Hazardous Materials in the Community"; and (5) "Community Action Project" (providing a framework to guide the action project). Each unit has 3-10 activities containing objectives, teacher preparation, class activity, follow-up, and handout materials. Three skill building activities, resources for teachers and students, and a glossary are appended. (YP)

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BAGS...
BEAKERS...
AND BARRELS...

AN ACTION CURRICULUM TOWARD RESOLVING HAZARDOUS MATERIALS ISSUES.

For Middle and High School Students.

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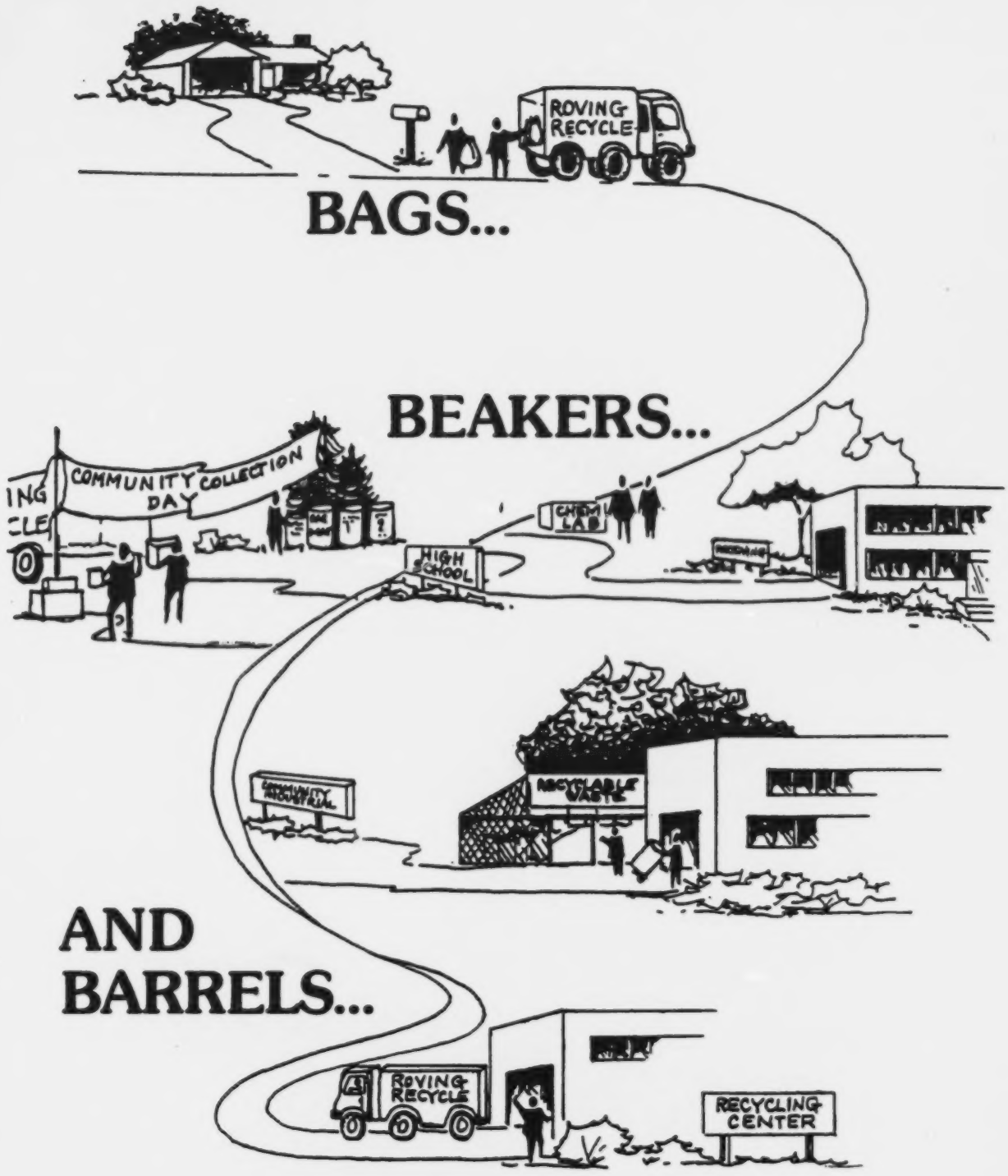

AN ACTION CURRICULUM TOWARD RESOLVING HAZARDOUS MATERIALS ISSUES.

For Middle and High School Students.

Bags, Beakers, and Barrels: An Action Curriculum Toward Resolving Hazardous Materials Issues.

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INTRODUCTION

The Industrial States Policy Center of Ohio, in cooperation with the Ohio Department of Education and the University of Michigan's School of Natural Resources, has developed the following curriculum program for Grades 7 - 12 to increase awareness of the hazardous materials problem on the local, state, national, and global levels. **Bags, Beakers, and Barrels** highlights an important "science-technology-society" issue and is most easily applicable to the science, health, social studies, and language arts disciplines.

The curriculum helps educators to meet the need for incorporating science-oriented social issues into the curriculum. By introducing the subject of hazardous materials and explaining their origins, students will become more aware of the issues and more knowledgable citizens. This curriculum material includes an opportunity to explore a local concern and take small steps toward a solution. As a result, students come to realize that they can play an active role in implementing positive change through developing knowledge of an issue and applying interpersonal and citizenship skills.

Throughout the development of this material, the project staff incorporated guidelines from the Ohio Department of Education's recommendations for developing a Course of Study in Energy and Resource Conservation Education. Because the Minimum Standards for Elementary and Secondary Schools state that the "courses of study shall provide for ... energy and resource conservation education to be a part of the curriculum," the state began work to develop guidelines for school districts to consider in meeting this mandate. That work was conducted simultaneously with this project. **Educators will find that this curriculum meets many of the curricular guidelines in other states, as well as in Ohio.**

Life-long Learning Skills

For instance, the state's guidelines emphasize the need for developing life-long learning skills in the curriculum, recognizing that environmental issues inherently require the application of these skills in their understanding. This curriculum will help students develop the following life-long learning skills:

- Critical Thinking
- Decision-Making
- Valuing
- Problem-solving
- Communication
- Human Relations

In addition to developing a stable foundation of skills, the curriculum includes group process activities (in Appendix A) designed to develop a greater awareness of students' attitudes and behaviors. For students to internalize the learning provided through the curriculum, it is essential for them to have acquired the skills necessary to take an active role in addressing these new and challenging aspects of our moral and environmental crisis. This aspect of the curriculum addresses another state guideline:

"An effective program should assist students to understand how attitudes are formed, how values are developed, and how ethical behaviors are manifested."

The Curriculum Format

The format for this curriculum has been designed for quick, easy reference by teachers. At the beginning of each unit, an introduction for the teacher contains general information on the unit, unit goals, and the overall flow of activities.

Each activity is numbered in sequence for each unit. Units are identified by a graphic icon under the activity title. A corner block in each activity describes the activity, materials, and time required. Then, the basic flow is as follows:

- Concept
- Objectives
- Class Activity
- Follow-Up
- Teacher Background
- Student Handouts

Answers to discussion questions are generally found in the text, unless they refer to information particular to your class or student. Words or concepts found in the glossary are in bold face print.

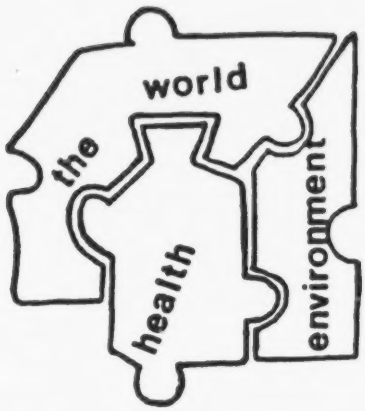
Using the Curriculum

This material is designed to help you and your class develop a better understanding of the problems associated with the generaion, use, and disposal of hazardous materials. Just as important, this curriculum will help to develop the skills necessary to implement solutions to those problems. Ideally, you and your class will use Unit 5, the Community Action Project, to identify a local aspect of the hazardous materials issue and to complete a community project to help resolve the problem.

Classes that are just becoming aware of the problems of hazardous materials should start with the first unit. It introduces the topic and defines the terms this curriculum will use. The curriculum proceeds with an investigation of homes, schools, and the community to explore the personal connection you and your students have to hazardous materials. After covering a few activities in all or some of the units, the class may be ready to choose a community action project. Use the remaining activities in Units 2, 3, and 4, to fill in the gaps and answer questions. Remember, at any time you feel the need to help students improve their group process skills, select one of the activities included in Appendix A.

The project staff invite you to explore this exciting and critical issue with your class, keeping in mind that this program was designed with the teacher in mind as well as the student. We have made every attempt to assist you in meeting existing requirements instead of creating new ones. Our hope is that it will provide challenging opportunities for personal and civic growth ... to open the door to creative problem-solving through cooperation at home and in the community.

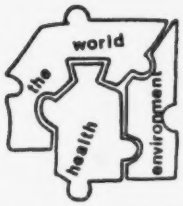
Unit 1
Connections



Launching any new study requires some common ground — a foundation upon which to build new concepts. This unit provides the common ground for this curriculum. In the first activity, students use local news articles and handout material to understand the definitions of toxic chemicals and hazardous waste, and the magnitude of this issue. Additional activities explore the potential health effects and global connections of commonly used toxic chemicals. Reading materials, group activities, discussions, and writing exercises help introduce these ideas and give your students opportunities to use them. Even in this introduction, the depressing reality of hazardous wastes may overwhelm some students. If so, please use the inserts, BRIGHT SPOTS ON THE HORIZON, in discussions as needed.

	ACTIVITY	Page
1.	***Current Issues***	1-3
	Use newspaper articles and the handout to introduce and define the topic.	
	Bright Spot: Multiple Opportunities	1-4
	Handout 1A: What are Toxic Substances and Hazardous Wastes?	1-5
2.	***What's Up Doc?***	1-7
	Diagnose patient ailments or sources of toxic contamination.	
	Teacher Background — Toxicity	1-8
	Bright Spot: One Chemical Combats Another	1-8
	Handout 2A: Health Effects Data Sheet	1-9
	Handout 2B: Patient Symptoms	1-10
3.	***Global Links***	1-11
	Map countries which risk hazardous waste contamination for blue jeans.	
	Handout 3A: What's Hazardous About Your Pants?	1-12
	Bright Spot: Pesticides Aren't the Only Way	1-12
4.	***Sharing Knowledge***	1-13
	Practice communication skills and review highlights of the hazardous waste issue.	

1. Current Issues



ACTIVITY: Individual and small group activity and discussion.
MATERIALS: Two handouts and newspaper articles.
TIME: One class period plus 5 minutes per period as appropriate

The handout is designed to supplement class discussions on local toxic substance and hazardous waste issues from local newspaper articles. If appropriate, feel free to use the definitions from the Glossary (See Appendix) as well.

OBJECTIVES:

- Students will define a toxic substance and hazardous waste.
- Students will improve their ability to work effectively in small groups.
- Students will continue building an awareness, interest and concern about toxic substances and hazardous waste.
- Students will develop research skills.
- Students will continue to develop communication skills.

TEACHER PREPARATION:

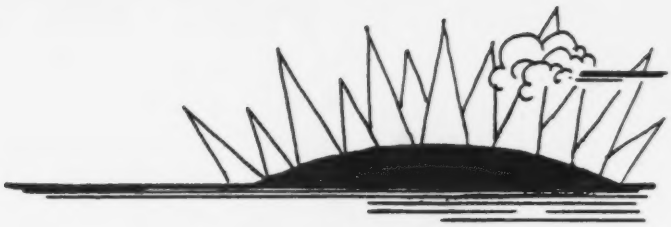
1. About a week prior to the introduction of this unit, have students cut out articles from magazines and the newspaper which relate to hazardous materials or wastes. Ask them to listen to television and radio news for reports of incidents or local concerns about hazardous substances.
2. Take five minutes each day to have a few students share their findings and start a current events bulletin board.
3. Copy Student Handout 1A for your class.

CLASS ACTIVITY:

1. After discussing the local hazardous waste issues the students have uncovered from news reports, distribute copies of the handout, "What Are Toxic Substances and Hazardous Wastes?"
2. Have the students carefully read the handout.
3. Divide the class into small groups to discuss the questions at the end of the handout.
   - How is a hazardous waste different from a toxic substance?
   - What are some of the concerns and problems related to hazardous waste?
   - Do you think you contribute to the hazardous waste problem? If so, how?
   - How can hazardous waste problems be prevented?
4. Provide time to answer questions in a group discussion afterward. Do the students have strong opinions, fears, or concerns to share? Can other students help answer questions and share opinions, letting you play the role of a facilitator?

FOLLOW-UP:

1. Find out if your municipality has a "Haz Mat" program (Hazardous Materials Incident Program) to respond to emergencies. Ask your local fire chief for details. If so, ask the team to provide a program about local hazardous waste incidents and the types of accidents they are prepared to handle.
2. Have students find newspaper and magazine articles in the library from past and current events involving toxic substances and hazardous wastes. Based upon the environmental or health effects of an incident or the material mentioned, have students determine what type of toxic substance or hazardous waste is described in each article (corrosive, ignitable, reactive, toxic, etc.) and discuss potential health and environmental hazards. Also discuss ideas for preventing emergency incidents. These articles can be added to the bulletin board.



MULTIPLE OPPORTUNITIES

Hazardous wastes are a byproduct of a technological society. When we demand stronger nylon, lighter metals, and whiter whites, the chemists go to work. These new synthetics, alloys, and bleaches create more hazardous wastes. The wastes are an environmental problem because of a combination of ignorance, economics, politics, and poor technology.

Such a multi-faceted issue provides innumerable opportunities for solutions, many of which are currently underway around the world. Industries are devising ways to a) produce the same product with less waste, b) produce a product which does not generate hazardous wastes, c) recycle and reuse chemicals that were formerly wastes, and d) exchange waste products with an industry which can use those wastes as valuable resources for the development of a new product.

Consumers play an equally important role by purchasing products that generate less waste, or altering their lifestyle to rely less on the worst synthetic materials. Governments are helping to fill gaps providing regulations for disposal, standards for clean-up, and economic incentives to prevent hazardous waste problems at their origin.

Some of your students may become chemists, business executives, shop owners, or decision makers who will have an opportunity to implement solutions to future hazardous waste issues. They will all be consumers and voters and through their actions may help make a difference.

STUDENT HANDOUT 1A

WHAT ARE TOXIC SUBSTANCES AND HAZARDOUS WASTES?

CASE STUDY 1.
After hard rains in 1975 and 1976, some families living near Love Canal, New York noticed dark, smelly liquids seeping into their basements. By 1978, a health study indicated startlingly high rates of miscarriages, birth defects, and liver disease among the people living closest to the abandoned chemical dumpsite, buried beneath the neighborhood school's playground. With President Carter's declaration of a federal emergency, over 200 families were evacuated from the area and their homes destroyed.

CASE STUDY 2.
The residents of Minimata City, Japan suspected a problem when the local cats began to twitch, jump for no reason, and walk crookedly. The "dancing cats", who usually ate scraps from the fish cleaning operation on the docks, had brain damage from mercury poisoning. By the time the local chemical plant admitted responsibility for releasing mercury into the bay, over 100 people in the town were seriously injured or dead.

Not all problems with toxic chemicals are so far away. Have there been any accidental poisonings with pesticides, household cleaners, or medicines in your area? Even small rural towns may have problems with toxic agricultural chemicals, or accidents while trucks transport chemicals across our nation's highways.

The chemicals in question in each of these examples are toxic to human beings. When these chemicals are thrown away or released into the environment, they became hazardous wastes.

What Are Toxic Substances?

If you were to ask a geologist and an EPA official to define a "toxic substance" you may get two different answers. Although scientists may agree on certain definitions, policy-makers often have a different perspective. Similarly, a universal definition does not exist between countries.

In the broadest sense, a **toxic substance** is something which can produce an adverse biological effect in a living organism. This could be in a human, wild animal, plant, or bacteria. A toxic substance can damage living tissue, cause birth defects, illness, or death, but only when the organism comes in contact with the chemical. Toxic chemicals are usually a problem when they are eaten, inhaled, or absorbed through the skin.

Any substance, when used improperly or found in certain concentrations, may be considered toxic. Even water can be toxic; people have actually died because they drank too much! Similarly, arsenic can be considered safe if it is properly sealed, but highly toxic if released into the environment.

The amount of a substance required to trigger a toxic reaction varies according to the nature of the substance, the way the chemical gets into the body, the length of exposure, and concentration of the substance. For example:

Acute Reaction: results from an exposure of short duration; one quick exposure to this type of substance can be toxic. Employees of industries who work with chemicals are often at the greatest risk of an acute exposure.

Chronic Reaction: results from exposures over a long period of time, or repeated exposures. In most cases, a single exposure to this type of substance does not result in a toxic reaction. Because chronic reactions occur after a long time, it is difficult to attribute an illness to that exposure. It is also difficult to monitor these changes over time. Few scientists know for certain what health effects to expect from any repeated exposure.

What Are Hazardous Wastes?

When toxic substances are no longer in their original useful state, but are still toxic, they are "hazardous wastes". Many hazardous wastes are created as by-products of various industrial processes and require special treatment before they can be disposed properly. Other substances, such as road salt contribute to the hazardous waste problem. Even some wastes generated in our homes can be considered hazardous wastes. Furthermore, substances can be hazardous even if they are not toxic. By definition, a **hazardous waste** is a waste that is a substantial threat to human health or the environment when improperly managed.** The following categories of wastes are considered hazardous:

Ignitable wastes can catch fire in the presence of spark, water, or friction during transport, storage, or disposal. Examples are: gasoline, alcohol, propane, kerosene and turpentine.

Corrosive wastes include strong acids (pH of less than 2) and bases (pH more than 12.5). They destroy metal containers, skin, and other materials. Examples include battery acid, ammonia, and spent pickle liquor from the steel industry (mostly hydrogen fluoride), benzene, and acetyl chloride.

Reactive wastes are highly unstable and can explode or release highly toxic gases when exposed to heat, water, pressure, or other wastes. Examples are: ether, picric acid, and potassium metal.

Toxic wastes can produce acute or chronic health damage. These wastes can cause birth defects, cancer, nervousness, fatigue, or death. Toxic wastes can be either organic chemicals such as the hydrocarbons, DDT, PCB, and dioxin, or inorganic chemicals like lead, mercury, zinc, asbestos, and cadmium.

Radioactive wastes come from nuclear power plants, hospitals, laboratories, and weapons plants. These wastes emit radiation that may cause genetic damage, cancer, or death. Examples: Berium, Iodine, Uranium 238, Plutonium.

Explosive wastes cause a rapid chemical or nuclear reaction with the production of noise, heat, and violent expansion of gases. Examples: old ether, picric acid, nitroglycerine.

Discussion Questions:

1. How is a hazardous waste different from a toxic substance?
2. What are some of the concerns and problems related to hazardous waste?
3. Do you think you contribute to the hazardous waste problem? If so, how?
4. How can hazardous waste problems be prevented? List some ways.

**Resource Conservation and Recovery Act of 1984.

2. What's Up Doc?

ACTIVITY: Small group work.
MATERIALS: Two handouts.
TIME: One class period.

A toxic chemical is dangerous only when a living organism is exposed to it. It is possible for a worker to handle very dangerous substances in relative safety. Unfortunately, mismanagement, ignorance, and accidents put the workers in many jobs at risk of exposure to toxic chemicals. By using the ailments listed from the fictitious people and the information on toxic chemicals and their health effects, students will understand the severity of the chemicals in our environment. This activity may be made more challenging by splitting Handout 2A into two pages, and giving each student only one half. This will necessitate high quality communication to solve the puzzles.

OBJECTIVES:

- Students will begin to understand how vulnerable the body can be to damage from toxic chemicals.
- Students will learn how different chemicals affect different parts of the body.
- Students will learn how these chemicals enter organisms and the environment.
- Students will practice communication and problem solving skills.

TEACHER PREPARATION:

1. Duplicate Handouts 2A and 2B.
2. If your class would like a more challenging activity, cut Handout 2A in half, crosswise.
3. Review the Teacher Background section if you need more information.

CLASS ACTIVITY:

1. Divide the class into small groups, or into pairs, or ask the class to form small groups, as you prefer.
2. Distribute Handouts 2A and 2B, challenge the students to determine what is "wrong" with each patient in Handout 2B. They may use clues from the workplace and the patient's symptoms.
3. Every person in each group must agree on the diagnosis.
4. Suggested answers to the patient symptom scenarios are as follows: 1. Asbestos, 2. Hydrogen Sulfide, 3. Cadmium, 4. Benzene, 5. Mercury.
5. When the groups have finished, lead a discussion to see if all the groups agree and explore any of the following discussion questions.
   - Why do so many chemicals damage the liver? What is the function of the liver?
   - For each of the symptoms given, discuss if it is chronic or an acute effect of an exposure.
   - What is the difference between a mutagen, teratogen, and carcinogen? Could one chemical be all three?

FOLLOW-UP:

1. Invite students to explore the health effects of toxic chemicals in more detail. What toxic chemicals are most common in your community?
2. Contact local unions from manufacturing industries and request that a health and safety representative come to speak to the class regarding health problems workers have experienced and the measures which have been taken to provide protection.

TOXICITY

A toxic chemical is defined as any chemical that when inhaled, ingested, absorbed, or injected into the body has a noxious effect on the body - reversible or irreversible. Toxic effects may also arise as the side effects in response to some medications, vaccines, and exposure to chemicals.

Toxicity: is the ability of a chemical substance to produce harm or injury to a living organism when the chemical has reached a sufficient concentration. The chemical injury may be local or systemic.

Local Injury: is injury that results from direct contact of the chemical with tissue. This chemical can irritate the skin, eyes and the lungs.

Systemic Injury: is injury from a substance that affects the body tissue after absorption into the bloodstream. A material cannot produce injury unless it gains entry into the body. Common *routes of entry* are ingestion, injection, skin absorption and inhalation. A chemical which causes systemic injury generally enters by one of these routes and then enters the bloodstream, where it may cause general effects or critical injury to specific tissues or organs.

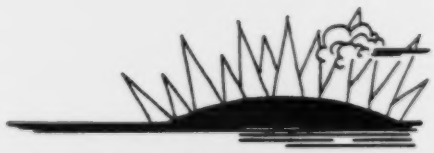
Threshold limit value (TLV): is the estimate of the average safe toxicant concentration that can be tolerated on a repetitive basis, for an eight hour period on a day to day basis. A sufficiently small amount of most chemicals produces no injury or "no effect".

All chemicals do not follow the same exact pathway through the body. Some chemicals primarily damage the central nervous system and others may damage the liver. Toxics can also be described as *carcinogens, mutagens, and teratogens.*

Carcinogen: is any agent that produces and/or accelerates the development of malignant tumors or abnormal growth of cells.

Mutagen: is an agent that affects the DNA so that it may produce cancer or a mutation in a future generation. People who work with a certain chemical may not be hurt by it, but their offspring may be. Radiation is a mutagen that has been associated with sterility.

Teratogen: is an agent that interferes with normal embryonic development. Chemicals given to a pregnant animal may produce birth defects without damaging the mother.



ONE CHEMICAL COMBATS ANOTHER

Workers at a kepone plant in Virginia were contaminated with high levels of an insecticide powder in the 1970's. Shortly after, physicians at the Medical College of Virginia found a drug to speed up the body's natural elimination rate of kepone. The level of kepone in the workers is significantly lower with this treatment.

STUDENT HANDOUT 2A

HEALTH EFFECTS DATA SHEET

What Parts of the Body are Affected?

Arsenic
Liver, skin and lung cancer
Greatest threat from inhalation

Asbestos
Lung and intestinal cancer
Asbestosis
A fiber that damages lungs when breathed by irritating the fragile tissue

Benzene
Leukemia
Central Nervous System Disorders: headaches, nausea, unconsciousness
Is rapidly absorbed by the blood system where it causes damage

Cadmium
Kidney damage
Bone brittling
Accumulates in the body and food chain

Hydrogen Sulfide
Respiratory track damage
Central Nervous System Damage: headaches, nausea, blurred vision, absorbed by blood stream when inhaled

Mercury
Brain damage
Absorbed through intestinal track, carried by blood stream when inhaled

Trichloroethylene
Liver and lung cancer
Loss of nerve sensations
Skin irritant

Vinyl Chloride
Liver and kidney cancer
Central Nervous System disturbance, Dermatitis
Reproductive Effects

Which Workplaces?

Metal Refining (Copper, Lead, Zinc, etc.)
Arsenic
Cadmium
Platinum (compound)

Textile Industry
Arsenic
Asbestos
Benzidine

Metal Finishing
Cadmium
Platinum

Construction Industry
Benzene
Tricholoroethylene
Asbestos

Chemical Industry and Plastics
Benzene
Hydrogen Sulfide
Tricholoroethylene
Vinyl Chloride

Paper Industry
Hydrogen Sulfide
Benzidine

Pesticides/Fertilizer
Cadmium
Arsenic
Mercury

Fossil Fuels (burning and production)
Arsenic
Benzene

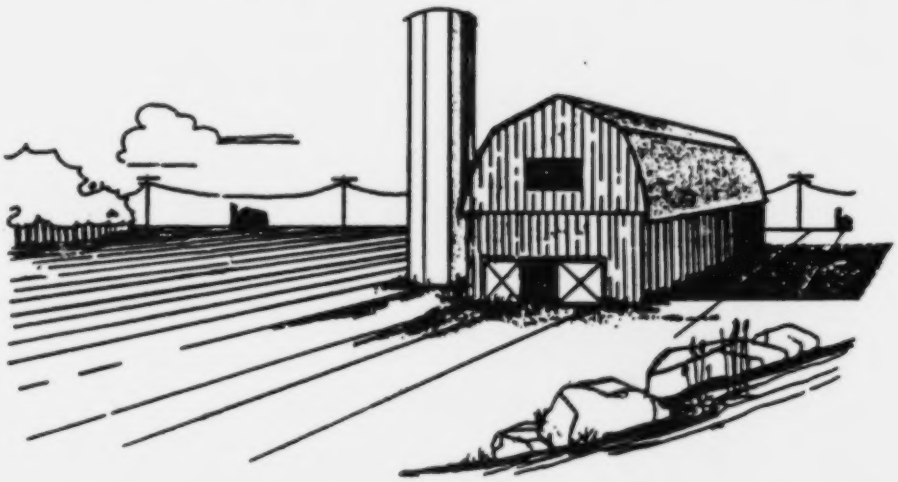
STUDENT HANDOUT 2B

PATIENT SYMPTOMS

1. Sam has been a construction worker for ten years. His primary job is removing old insulation in the buildings his company remodels. Lately, he has noticed that he has difficulty breathing, both shortness of breath and chest pain. What might be the cause of his ailment? List the clue which helped you determine the cause.

2. In a freak accident at the Clean Sheet Paper Company, a cloud of toxic gas rolled across the local community. Most people reacted by coughing, but many of the elderly became quite sick. What was the chemical gas? Why do you suppose the elderly were severely affected?

3. Maria is a fisherman's wife. Her father was a fisherman, and her children probably will be. For most of her life she's lived with the clean, salt spray of the ocean. During her last visit to the local clinic, Maria discovered her kidneys do not function properly, and she wonders how she could have been exposed to a toxic chemical. Can you tell her? What types of industries would you expect to find in the area? If she lives in a rather rural area, what might you suspect caused her kidney problems?



4. An entire family is complaining of nausea, frequent colds, tiredness, and stomach cramps. They live on a farm in a rural area. No matter which way the wind blows, there is always a funny smell in their house. The farm one mile away has been sold to someone who is collecting barrels and drums. What might be bothering the family? What is the most likely route of exposure?

5. In the late 1700's, beaver pelt hats were the rage in Europe. The beaver furs were treated with a mercury compound during the processing, before they were sewn into hats. From where did the saying "mad as a hatter" come or the Alice in Wonderland character?

For each case described above, list a few protective measures that might have been taken by the people or the industry to prevent the exposure.

3. Global Links

ACTIVITY: Individual work.
MATERIALS: World maps, markers or colored pencils.
TIME: 20 minutes and homework.

It's easy to forget that our own actions affect the entire world. We use many raw materials that come from other countries which in turn are sold overseas. When it comes to hazardous waste, every industry risks contaminating the local environment which eventually affects the environment on a regional and global basis. Policies and technology may not be effective enough to clean up the chemicals properly in developing countries. Other factors, such as the market place or the political climate, may govern the method of hazardous waste management in developing countries.

OBJECTIVES:

- Students will begin to understand that common, everyday things have links all over the world.
- Students will review and improve their knowledge of geography.

TEACHER PREPARATION:

1. Obtain global maps and duplicate them for each student.
2. Duplicate Handout 3A.

CLASS ACTIVITY:

1. Distribute the maps and the handout. Ask the students to read about the global connections that jeans create, and to mark on their map the countries that might be involved in the production of their pants! Students may prefer to use different colors to differentiate raw materials from processing stages. Explain that wherever a resource is mined, harvested, or processed, there is usually a risk of hazardous waste contamination.
2. After the maps are marked compare maps, and have the students review the countries involved. Answer their questions, and encourage them to think about the global links for other products.
3. Ask the students to work in groups, selecting a manufactured product which they use that produces a risk of hazardous waste in its production and which is likely to have international roots. Examples include: cars, plastic items, a diamond ring, an aluminum can.
4. Have them research the ingredients used in the manufacture of this item and the source of these items.
5. Using more world maps, have each group map out the sources and connections that their product made with the rest of the world. Ask them to highlight potential hazardous waste locations.
6. As a class, discuss how the students feel about these global links. What impact does this have on America and on the people in other countries?

FOLLOW-UP:

1. In Chapter 4, the first two activities relate to everyday items that produce hazardous waste by virtue of their production: Hazardous Waste Card Games and Baker's Dozen.
2. You may want to refer back to Handout 2A to discuss possible health hazards to workers and living organisms potentially exposed to wastes in the environment.

STUDENT HANDOUT 3A

WHAT'S HAZARDOUS ABOUT YOUR PANTS?

Denim is made from cotton, which is grown in warm climates. Southern U.S., USSR, Brazil, Pakistan, Turkey, China, India and Egypt were top cotton producers in 1984.

Pesticides are sprayed on cotton fields to kill boll weevils. These chemicals have endangered workers and contaminated the soil.

In some cotton mills, workers risk brown lung disease from breathing airborne fibers.

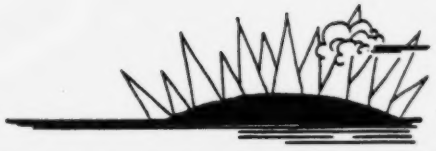
The patented rivets in Levi's jeans are made of copper. This ore is mined in Canada, Mexico, Peru, Chile, and the US.

What environmental problems might you find near the mines?

Blue dye is made from indigo, an export of Java, Japan, Brazil, and the West Indies.

Dye is a major source of water pollution from most textile plants.

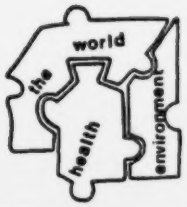
Energy is used to plant, spra and pick cotton; to mill and clean cotton; to dye and process the cloth, and to sew jeans. From where do we obtain petroleum fuel? The drilling, transporting, and processing of oil poses many potential hazards.



PESTICIDES AREN'T THE ONLY WAY

Cotton receives more pesticides than any other crop in the world, but it may not for long. Because of the great expense of petroleum-based pesticides, the health risk to field workers, and the potential harm to the soil, scientists and farmers are experimenting with new techniques to grow crops. They have had great success with integrated Pest Management. It uses naturally occurring pest controls (predators and parasites), sterile insects, crop rotation, and special plant varieties to increase crop yields. In Texas, farmers trying this new system used 50% - 75% less pesticide and 80% less fertilizer. Their profits tripled!

4. Sharing Knowledge



ACTIVITY: Individual writing
MATERIALS: Paper and pencil.
TIME: One period.

The reinforcement of new information and *real* learning often occurs when people teach someone else. The following ideas will help your students present information on hazardous waste to another person, improving their own knowledge and sharpening their communication skills. If you choose to save their writings until the end of your hazardous waste unit, the materials may provide an interesting way for the students to measure their own learning.

OBJECTIVES:

- Students will improve their hazardous waste - related vocabulary.
- Students will increase their concepts of hazardous waste.
- Students will be encouraged to feel a greater responsibility for the information they are learning and to want to share that information with others.
- Students will improve their writing skills.

TEACHER PREPARATION:

1. Read over the class activities, and either choose one for an assignment, or present all the ideas to the students, allowing them to choose one.
2. You may wish to save their work to return to them after you've completed more of this hazardous waste curriculum. It may be interesting for them to observe how their ideas and opinions have changed, and the effect that additional information had on them.

CLASS ACTIVITY:

1. Ask the students to consider the issues that concern them and their community and to write a letter to the editor of their school or community newspaper. A letter to an editor should be persuasive; it is an attempt to arouse interest or action for a particular cause. A sample is below.
2. Have each student choose three very important ideas about hazardous wastes that he or she would like to tell other students. Then ask them to write several paragraphs or a letter that conveys those important ideas. Students may choose to share their important ideas in a poem, story, or poster.
3. Ask the students to imagine themselves in 20 or 30 years, with children their age! Have them write down the most important things for their children to know and understand about hazardous waste. Will the world still have hazardous wastes?
4. Ask the students to write a news article which describes an incident where people were exposed to a toxic substance or hazardous waste, describing health effects and emergency action that were taken. Finally, ask them to conclude with a report of what is being done to prevent that type of incident from occurring again.

Sample Letter to the Editor

Dear Editor:

Last Saturday I stopped near Huggins Pond on a bike ride. It smelled pretty bad, and it wasn't long before I found the reason — dead fish. I heard that Del Mineo Company was warned to stop dumping in the river, and I think it's time we help them speed up their cleanup process.

Next Wednesday at the High School gym there will be a meeting of all interested people to talk about how we can apply pressure to help Del Mineo understand that we value live fish and clean air. I think it's time we all work together on this problem.

Sincerely,
John Nader

Unit 2

Hazardous Materials in the Home

The industrial hazardous wastes buried at Love Canal, New York or stored at Chem-Dyne in Hamilton, Ohio may seem distant and irrelevant to your students. Even though these chemicals may appear to be someone else's problem, the basic concerns from these sites are identical to smaller problems resulting from chemicals your students live with everyday: household hazardous wastes. Home chemical hazards may be just as toxic as the troublesome compounds that attract big headlines. In fact, an entire community may legally dispose of tons of toxic waste each year in the form of paint thinners, weed killers, and other common household hazardous wastes. The majority of this material goes to the municipal landfill or other facilities which are not designed to contain it. Without the benefit of guiding regulations, home and small generators (less than 100 kilograms per month) may unknowingly dispose of hazardous waste improperly.

On a larger scale, the United States produces over 35 million tons of toxic chemical waste per year. Many of these toxics are the byproducts of materials found in and around the home. The majority of this waste can be treated or recycled and yet industries need economic incentives and access to information to effectively implement solutions. With these facts in mind, it is important not only to find proper methods of disposal for hazardous waste but to understand the relationship between generation of waste and its disposal.

In this unit we will explore the potential hazardous waste that can be found in and around the home and what makes these materials hazardous. We will also look at present disposal methods with the potential for creating new disposal modes in your community. Activities throughout this unit will require group effort. If you find that your students need to improve their group skills to effectively address the tasks of the activities, you may want to refer to the activities in Appendix A or the ***Six Bits*** activity in Unit 4.

	ACTIVITY	Page
1.	***Reading Labels***	2-3
	Understanding product labels.	
	Handout 1A: Can Some of Your Household Products Harm You?	2-4
	Handout 1B: Be A Label Detective	2-5
2.	***Hazards in the Home***	2-6
	Discovering the kind & quantity of hazardous substances in the home.	
	Bright Spot: Mr. Yuck's Success	2-7
	Handout 2A: Home Hazardous Products Survey	2-8
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3.	***Disposal Systems***	2-10
	Investigating where & how we dispose of products & groundwater impacts.	
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4.	***Contamination***	2-15
	An experimental look at groundwater.	
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5.	***Creative Endings***	2-17
	Using scenarios to discuss sound home disposal techniques.	
	Bright Spot: Community Collection Day	2-17
	Handout 5A: Spring Cleaning & Summer Jobs	2-18
6.	***Test & Compare***	2-19
	Activities to examine non-toxic alternatives.	
7.	***Gearing Up For Action***	2-21
	Student selection of an action project.	

1. Reading Labels

ACTIVITY: Activity sheets, class discussion and small group work.
MATERIALS: Handouts and empty containers.
TIME: 1 class period.

Some of the most common and frequently used household products are actually toxic chemicals or contain toxic chemicals. When we throw away containers, we may be contributing to a local hazardous waste problem. The wise management of household hazardous waste begins with knowing which products pose a problem — by reading labels.

OBJECTIVES:

- ✔ Students will be able to find, read and understand the information on a product label.
- ✔ Students will understand that not all important information is given on the product label and therefore precautionary measures should be taken.

TEACHER PREPARATION:

1. Make copies of Student Handouts 1A and 1B.
2. Collect 10 - 15 containers of household hazardous materials, taking necessary precautions: Make sure the containers are empty (do not wash them out), tape lids shut, wrap the entire container in a clear plastic bag and tie off the top. This will protect students from any chemicals that may have dripped down the side and draw attention to the seriousness of the topic.
3. Optional: Make a copy of a sample label for the overhead projector.

CLASS ACTIVITY:

1. Briefly review with the class the definitions introduced in Unit One.
   - What makes a chemical or product hazardous material? (It may be toxic, corrosive, reactive, ignitable, explosive, generate pressure, or radioactive.)
   - What is a toxic chemical? (One that harms or kills plants/animals by poisoning them.)
   - When do toxic materials become hazardous wastes? (When they are spilled or thrown away.)
2. Ask your class to brainstorm a list of items in their home that are poisonous (toxic and therefore hazardous). Point out that humans may be poisoned by eating, drinking, or inhaling a poison, or by skin contact. See Student Handout 1A for a partial listing if the class needs assistance.
3. Ask how your students could discover which products are toxic, without poisoning themselves! Knowing the ingredients may help, but we rarely know the effects of the chemicals by the name alone. The easiest clue is the warning that should be printed on the label: DANGER, WARNING, CAUTION.
4. Distribute Student Handout 1A. Review the label signals (danger, warning, caution) and lethal dose of each. Do they have these substances in their homes? Are they easy to reach? How are they used? What happens when the product is used up?
5. Using an overhead projector, you may want to examine with the class a sample label.
6. Have students divide into small groups of 2-3 people. Distribute Handout 1B and a container you have prepared for each group. Ask them to read each label and answer the questions using the label from the container. If time allows, have groups trade containers.

FOLLOW-UP:

1. In small groups, ask your class to design labels for any hazardous materials of their choice. They will have to agree on the product, and how much information to include and exclude.
2. Contact the Council on Hazardous Material, 4115 Bridge Avenue, Cleveland, Ohio 44113 for more information on household hazardous waste. The clearinghouse has a speaker's bureau and household hazardous waste collection program.

STUDENT HANDOUT 1A

CAN SOME OF YOUR HOUSEHOLD PRODUCTS HARM YOU?

WIPES OUT SOAP SCUM TOO.
TILE
CLEANER
WARNING:
EYE IRRITANT. KEEP OUT OF REACH OF CHILDREN. USE ONLY IN WELL VENTILATED AREAS. SEE ADDITIONAL PRECAUTION.
NET 16 FL. OZ.

TOXICITY RATING	LETHAL DOSE FOR 150 lb. HUMAN	HOUSEHOLD PRODUCTS...
Practically Non-Toxic	More than 1 quart	foods, candies, lead pencils, eye makeup
Slightly Toxic	1 Pint to 1 Quart	dry cell batteries, glass cleaner, deodorants, and anti-perspirants, hand soap
CAUTION: Moderately Toxic	1 Tablespoon to 1 Pint	antifreeze, automotive cleaners, household bleaches, many detergents, dry cleaners, most oven cleaners, many general cleaners, most fuels, lubricating oils, most stain and spot removers, many disinfectants, floor polish, shoe polish, most paints.
WARNING: Very	1 Teaspoon to 1 Tablespoon	toilet bowl cleaners, some deodorizers, engine motor cleaners, some fertilizers, some paint brush cleaners, some paint and varnish removers, fireworks, some mildew proofing, air sanitizers, some paints, lacquer thinners, many pesticides: DDT, chlordane, heptachlor, lindane, mirex, diazion, malathion, diquatdibromide, endothall,2,4D.
DANGER: Extremely Toxic	1 Drop to 1 Teaspoon	some of the insecticides, fungicides, rodenticides, herbicides: aldrin, eldrin, bidrin, paraquat, some fertilizers and mercury batteries.
Super Toxic		a few pesticides like: paroxon, phosdrin, parathion, isobenzan, pyrazoyan.

STUDENT HANDOUT 1B

BE A LABEL DETECTIVE

Directions: Carefully read the label on your container and answer the following questions as completely as possible.

1. What is the name of the product? _____

2. What is it used for? _____

3. What are the active ingredients? _____

_____

_____

4. Does this product have a signal warning? What is it? _____

_____

5. Briefly describe, from the label, how the product should be used. With normal use, does any of the product escape into the environment?

_____

6. What are the health or environmental problems associated with this product? _____

_____

7. List any directions that help protect people's health and the environment. _____

_____

8. Is there any other helpful information on the label? _____

_____

9. What information do you think should be on the label that is not there? _____

_____

_____

2. Hazards in the Home

ACTIVITY: Activity sheets, class discussion and research.
MATERIALS: Handouts.
TIME: Overnight and 1 class period.

To understand the potential magnitude of the household waste problem, students will survey their home and extrapolate their findings in the community. After collecting this data, they can use this information in future activities or in a class project.

OBJECTIVES:

- Students will become familiar with the hazardous substances in their home.
- Students will practice collecting and organizing data.
- Students will understand that individual behavior plays a role in hazardous waste generation.
- Students will gain an appreciation for the quality of household hazardous substances in their community.

TEACHER PREPARATION:

1. Make copies of Student Handouts 2A and 2B. The first will be completed at home, and 2B will be used in class the following day.

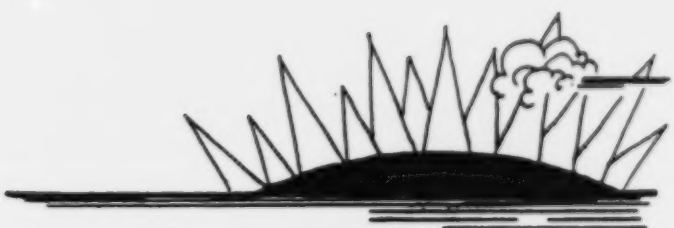
CLASS ACTIVITY:

1. Distribute the 'Home Hazardous Product Survey' (2A) to your students and ask them to complete it at home. Encourage them to tackle this one with their family; it will be a good opportunity to practice safety around household toxic materials with other family members. You may want to inform the parents of your students' assignment prior to this, so that they might assist students in a safe home investigation.
2. When the Home Surveys are completed, each student will be more knowledgeable about his or her family's use and storage of household hazardous products. Pass out the 'Class Data Sheet' (2B) to each person or group. It may be useful to have one class member record data on the blackboard as students complete Part I of their forms. When the information is totaled and averaged, discuss the results with the class:
   - What is the largest category for household hazardous materials? The lowest?
   - What might this mean?
   - Do your students think this data is the same in every community in your area? In every country?
   - Ask each student to compare his/her data with the class average--is it above or below? Why?
   - Based on the labels that the students read at home, which category of materials may be the most dangerous? In what part of the home were the greatest number of **danger** labels read?
   - What precautions do the students take with the materials they use themselves when they store, use and dispose of them?

3. Next, continue with Part II of the Class Data Sheet. How could the class find the number of households in your community? (A few phone calls, preferably placed by the students, to a planning agency, the city housing department, or the local utility company may help uncover population statistics.)
4. With the community totals, it may be easy to see how an individual's behavior and choices can quickly become an important aspect of the hazardous waste issue; when all of our actions are added together, our everyday practices might exceed an industry's wastes!
   Ask your students to consider their data and the survey:
   - Do these totals seem to reflect those in the community?
   - Do people in different areas of the community use different amounts of household hazardous materials? (Apartment renters and home-owners probably have different quantities of pesticides, paint, etc., as would urban and rural residents.)
   - What might be some of the problems associated with this method of data collection? (Volume, danger level, age, frequency of use, and type of product use are not considered; every container is counted equally.)
   - Based upon the calculated number of harmful household hazardous materials in your community from Handout 2B, *compare* to a "small quantity generator" (a business which generates 100-1,000 kilograms per month as defined by RCRA).

FOLLOW-UP:

You may want to have the students graph the results of their survey. This may make their information easier to share with others and useful in upcoming activities.



MR. YUCK'S SUCCESS

To help educate children about toxic substances in the home, a group in Pittsburgh, Pennsylvania started the Mr. Yuck program. The idea is to put an 'ugly face' sticker on products which are toxic, thus teaching even very young children to stay away. There are other programs sponsored by local Poison Control centers which stress education to help prevent poisoning. Perhaps through hazardous waste education we can also prevent poisoning of our environment.

HOME HAZARDOUS PRODUCT SURVEY

Directions: Look through your house to find the products that are used in each of the following areas. Read the labels to determine if the product you have is potentially hazardous. If it is, put a check in the blank to the left of the item. Estimate the number of containers, and write that number in the blank that follows the item. Circle the products that you personally use. Please check with a parent before starting this project: They may wish to learn from the survey, too!

KITCHEN:
___ oven cleaner ___
___ floor cleaner and wax ___
___ disinfectant cleaner ___
___ ammonia ___
___ scouring powder ___
___ bleach ___
___ other ___
Total Containers: _____

LIVING ROOM: (Look in a nearby cupboard or closet)
___ rug cleaner ___
___ furniture polish ___
___ air freshener ___
___ other ___

Total containers: _____

LAUNDRY ROOM:
___ bleach ___
___ spot remover ___
___ detergent ___
___ other ___
Total Containers: _____

LAWN:
___ weed killers ___
___ insecticides ___
___ fertilizers ___
___ other ___
Total Containers:

BATHROOM:
___ disinfectant tub/tile cleaner ___
___ drain opener ___
___ toilet bowl cleaner ___
___ medicine ___
___ other ___

Total Containers:_____

WORKBENCH:
___ paint ___
___ varnish ___
___ glue ___
___ paint thinner ___
___ furniture stripper ___
___ wood preservative ___
___ other ___
___ photographic supplies ___
Total Containers: _____

GARAGE:
___ oil ___
___ antifreeze ___
___ rat poison ___
___ gasoline, kerosene,
___ other fuel ___
___ pool chemicals ___
___ other ___
Total Containers: _____

OTHER PLACES AND ITEMS:
_____
_____
Total Containers:

TOTAL NUMBER OF HAZARDOUS MATERIALS IN YOUR HOME:
_____

STUDENT HANDOUT 2B

CLASS DATA SHEET

PART I:

Tally the number of household hazardous materials in each category from all the households in your group. Then total again to find the class's entire collection of toxic containers.

	GROUP	CLASS
Kitchen	_____	_____
Living Room	_____	_____
Laundry	_____	_____
Lawn	_____	_____
Bathroom	_____	_____
Workbench	_____	_____
Garage	_____	_____
Other	_____	_____

TOTAL: _____ (a)

PART II:

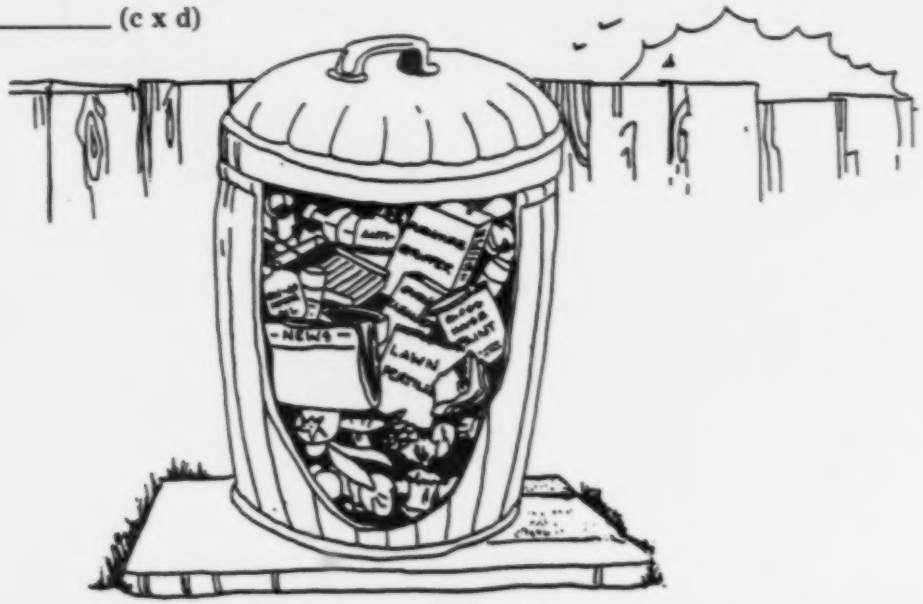
Number of households surveyed: _____ (b)

Average number of hazardous materials per household: _____ (a ÷ b = c)

Number of households in your community: _____ (d)

Your estimate of the number of household hazardous materials in your community:

_____ (c x d)



3. Disposal Systems

ACTIVITY: Activity sheets, class discussion and small group work.
MATERIALS: Handouts.
TIME: 1 - 2 class periods.

Household hazardous substances are not hazardous wastes until they enter the environment. For some products, simply using them releases the toxic product into the air, water, or ground (pesticides, herbicides, air freshener, etc.) For others, the problem does not arise until the product or container is thrown away. This activity explains three different systems into which household hazardous substances may be disposed; and discusses groundwater -- the ultimate resting place for many toxic chemicals, particularly when no system is used.

OBJECTIVES:

- Students will understand the basic functions and principles of three disposal systems.
- Students will understand the principles of groundwater and its regeneration.
- Students will understand the relationship between hazardous waste disposal and possible groundwater contamination.

TEACHER PREPARATION:

1. Make copies of Student Handouts 3A, 3B, 3C, & 3D.
2. Decide which of the following approaches would be best for your students:
   A. Copy handouts with the questions at the bottom and distribute to each student as homework.
   B. Copy handouts with the questions at the bottom. Have the class divide themselves into four groups and distribute an area of disposal or groundwater to each group. Allow enough time so they may brainstorm and/or research the answers.
   C. Copy handouts with questions covered. Distribute one area to each group and ask them to research possible sources of contamination and misuse of their form of disposal.

CLASS ACTIVITY:

1. Based on the approach you have selected either form small groups or assign work to individuals or let individuals choose their assignment.
2. Once the work has been completed, assemble the class and allow the groups to present the information they found. Open a discussion and critique the information gathered. What parallels were discovered between groups? What were the discrepancies? What questions does one group have for another?

FOLLOW-UP:

The next three activities, 4 - 6, may be useful in further clarifying the concepts of disposal and the interrelationship between waste, geology, lifestyle, water, and industry.

ENGINEERING ADVANCES

A major problem with solid waste landfills is that their liners do not always prevent contaminated water from leaching through to groundwater below. Members of the solid waste industry have engineered ways to protect groundwater from this danger. One method includes detecting and collecting leachate from the landfill and analyzing its contents. Once the individual chemical components of the leachate are determined, an appropriate treatment scheme to remove the contaminants is designed. This scheme often includes aerating, clarifying, filtering the leachate, then neutralizing remaining contaminants. A carefully engineered system can remove contaminants very efficiently and the treated leachate can often be safely discharged directly into the local sewer system.

STUDENT HANDOUT 3A

LANDFILL

Most solid waste, including improperly discarded hazardous materials, from households, schools, and businesses (paper, cans, glass) eventually ends up in the local licensed sanitary landfill. These large pits are usually lined with clay and/or industrial strength plastic to prevent **leaching** of contaminated water. In the past, many communities burned this waste on a daily basis, however air quality was greatly affected by this practice. Presently, the methods of compaction and burying are used. At the end of each day, the waste is smashed and covered. The process is repeated each day. Once the pits reach full capacity, they are completely covered and sealed with clay, which is designed to prevent water from percollating through the waste.

One major problem associated with landfills is that the clay and/or plastic layers do not always prevent contaminated water from leaching through. Another problem arises from the disposal of hazardous waste in local sanitary landfills. Many of these landfills were not designed to contain certain hazardous materials. Contacting your local sanitary landfill and/or hazardous waste disposal site may give additional insight.

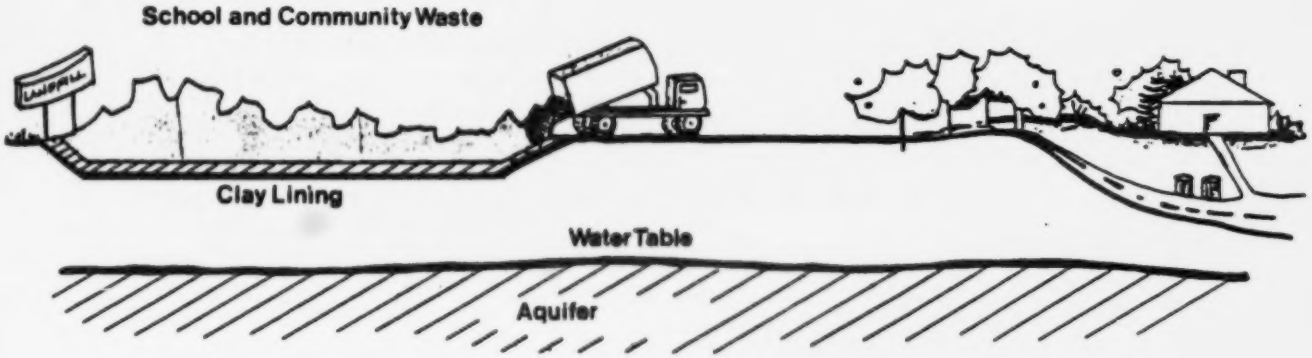
Discussion Questions:

1. Which household hazardous wastes might be disposed in a sanitary landfill? How could these household hazardous wastes contaminate the environment?

2. What are the basic guidelines for sanitary landfills in your state and who is responsible for enforcing those regulations?

3. What are the consequences of an improperly built landfill?

LANDFILL



SEPTIC SYSTEMS

Many communities, as well as some drive-in theaters and shopping centers, operate on private septic disposal systems. Traditionally, these systems handle many of the same type of substances that are received by city wastewater treatment (waste water from sinks, drains and pipes, and toilets). These communities are usually in areas that cannot be serviced by city waste water treatment due to distance or unavailability of hook - ups. This system consists of two basic elements: a septic tank and an absorption field. A **septic tank** is simply a tank that is buried in the ground to collect and treat the sewage. Wastewater flows into the tank where it is broken down by **aerobic** (utilizing oxygen) and **anaerobic** (without oxygen) bacteria. To continue functioning properly, the tank may need to be emptied periodically, by pumping, out the built up solid waste or sludge. That material is sent to the local sanitary landfill.

The solid wastes settle to the bottom and the **effluent** (wastewater) flows out to the overflow pipe, it is carried by gravity through the pipe to the absorption field. An **absorption field** consists of perforated tiles laid in gravel or crushed stone. The wastewater or effluent travels through the perforated pipes and trickles into the soil. The soil acts as a filtering system where additional aerobic decomposition takes place. In a properly constructed septic system, the effluent should be free of organic waste by the time it reaches the water table. Some household chemicals (ie. concentrated drain cleaners) may destroy the bacteria in a septic tank. Without the bacteria decomposing the waste, the treatment ability of the septic system decreases.

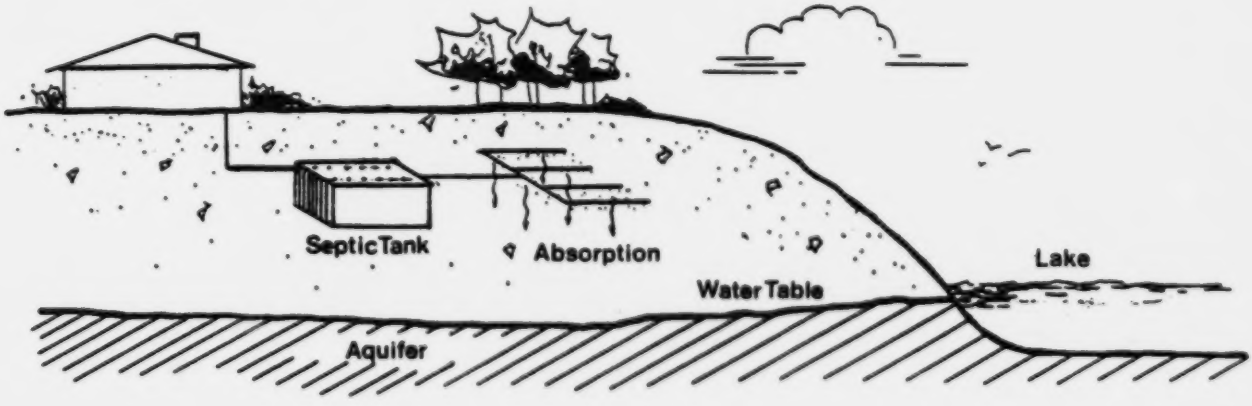
Discussion Questions:

1. List 5 household hazardous materials that end up in a septic system, either when used or disposed. Would the septic system be able to treat that material?

2. What are the guidelines in your community for septic system construction and maintenance? You may want to contact the city or county health department.

3. If these guidelines are not met, what may be the possible consequence?

SEPTIC SYSTEM



STUDENT HANDOUT 3C

MUNICIPAL WASTEWATER TREATMENT

The most common system for treating household wastewater (from sinks, tubs, toilets, floor drains) on a municipal level is sewage or wastewater treatment. Through a series of pipes the raw sewage from homes, businesses, and industries is carried to the wastewater treatment plant. Here the solids are removed and the effluent treated, and discharged into nearby rivers or streams. Some wastes are not allowed to be placed in the system if they might damage the operation of the treatment plant.

There are two kinds of sewer systems: separate and combined. A **separate system** collects raw sewage in sanitary lines and delivers it to a wastewater treatment plant. Rain water and materials from streets flow into separate storm water lines and are normally discharged to a nearby river or stream. If more sewage is delivered to the plant than can be handled, some raw sewage may bypass the plant or be held in a retention basin for later treatment. In a **combined system,** sanitary lines and storm water lines flow together into the wastewater treatment plant. During heavy rain storms, some of the combined rainwater and sewage may bypass the treatment plant and go directly into a stream or river without any treatment at all. In some cases it can be stored in a retention basin for later treatment.

PRIMARY STAGE

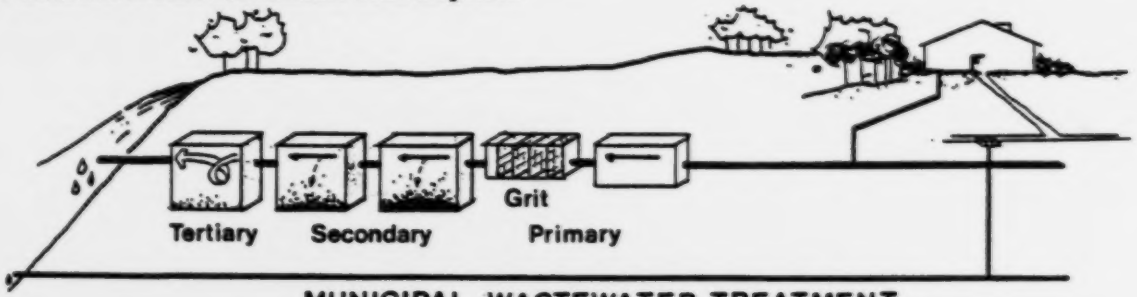
When the sewage arrives at the plant, if flows through a grit chamber which settles out large grit and particles. From the grit chamber, the wastewater flows through a series of screens which collects and shreds medium-size debris such as paper. The openings of the screens diminish in size, collecting smaller and smaller bits of material. The material collected by the screen is taken to a sanitary landfill and the wastewater which passes through the screens flows to sedimentation tanks. In the sedimentation tanks, the velocity of the water is greatly decreased allowing solid material to settle to the bottom where it is scraped into hoppers and transferred to sludge treatment tanks for further decomposition and disposal in a landfill or incinerator. The effluent is now ready for secondary treatment.

SECONDARY STAGE

In the secondary stage, up to 92 percent of the organic material remaining in the effluent is digested by aerobic bacteria utilizing oxygen. Basically, the effluent is brought into contact with large numbers of live bacteria which consume a majority of the organic matter. Sprayers or bubblers add oxygen to the water to maintain a healthy environment for the bacteria. The wastewater is then sent to a final settling tank where chlorine is added to disinfect the water before returning the treated wastewater to the river.

TERTIARY STAGE

Some communities treat their wastewater with an additional third stage. Tertiary treatment systems are used to remove additional organic and inorganic material (nitrogen, phosphorus) from the effluent and to increase the quality of the plant's effluent. Sand filtration or spray irrigation systems filter most of the remaining small quantities of particles and waste material out, providing around 99 percent organic and inorganic waste removal. Some tertiary systems are so efficient that the effluent is safe for human consumption.



MUNICIPAL WASTEWATER TREATMENT

Discussion Questions:

1. State what you feel would be the advantages and disadvantages of both the separate and combined wastewater treatment systems. Which type of system does your community have?
2. What would be the consequence of releasing raw sewage into a stream or river?
3. Are there any materials that cannot be handled by this type of system?
4. List 5 household hazardous materials that end up in a municipal wastewater treatment plant when used or disposed. How might they effect the system?

STUDENT HANDOUT 3D

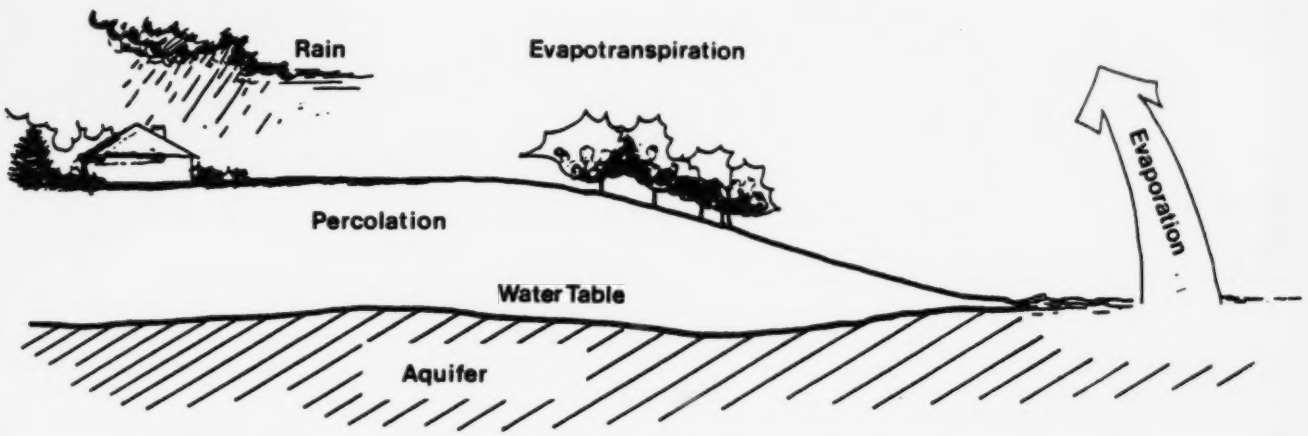
GROUNDWATER

Groundwater is the water which accumulates below the ground's surface. It percolates, or trickles down through porous soil. In some locations there are large amounts of water, called aquifers, trapped within rock formations or found in underground sand and gravel deposits. It is from these aquifers that we receive the majority of our drinking water. A variety of sources have the potential to contaminate this sub-surface water.

Aquifers and groundwater are a renewable resource made possible by the **hydrological cycle.** Moisture evaporates from the surface at the ground and from bodies of water (lakes, rivers, and streams) or evapotranspires from trees and shrubs. When the density of the vapor reaches a critical point, the vapor begins to form clouds. If this process continues, the clouds will release moisture in the form of rain. The rain will either be absorbed by the ground and percolate to the water table and recharge the aquifer, or it will run off the surface to a lake, river or the ocean. The surface area in which the water drains to a common location is called a **watershed** or drainage basin; it can be imagined as the valley between two adjoining roofs. Watersheds may be protected by local, state and/or federal legislation. The hydrologic cycle and watersheds are also highly dependent on soil conditions which determine the rate of percolation, surface cover (soil, vegetation, paving), and climatic factors.

Discussion Questions:

1. What surface and subsurface sources could result in contamination of groundwater?
2. When groundwater is contaminated, what are 3 consequences to humans and/or animals?
3. What are three ways to prevent groundwater contamination?
4. Once an aquifer is contaminated, how long do you think it would take to cleanse itself? What could be done to clean it?



4. Contamination

ACTIVITY: Experiment, observation & writing.
MATERIALS: Depends on chosen experiment(s).
TIME: 1 class period.

The concept of groundwater and its contamination by hazardous waste is difficult for most students to visualize. This activity describes three experiments which may be used to clarify the process. You may use any one, two, or all three. This is also a good opportunity to introduce the scientific method of writing as an orderly way to explain problems and solutions.

OBJECTIVES:

- Students will illustrate the process of groundwater contamination by experimentation.
- Students will practice writing and thinking in a scientific method format.
- Students will gather and record data.

TEACHER PREPARATION:

1. Read over the three groundwater contamination experiments (Student Handout 4A) and decide which you will have your class try.
2. Line up listed materials for each experiment.

CLASS ACTIVITY:

1. Have students divide into small groups for the experiments. Determine which group will do which experiment.
2. Introduce the five step scientific method to students: A) Stating the Problem, B) Forming the Hypothesis, C) Observing and Experimenting, D) Interpreting the Data, E) Drawing Conclusions.
3. Students should work through steps A and B as a group before beginning the experiment. Each student will turn in an individual report at the end.
4. As students draw conclusions about their experiment, ask them to consider how this relates to our hazardous waste disposal practices and our home water supplies.

STUDENT HANDOUT 4A

GROUNDWATER CONTAMINATION

EXPERIMENT 1: How Does Groundwater Move Through the Ground?

MATERIALS: Clear plastic box (like a sweater box), light- colored dry sand, bright food coloring, jar, water, clock, ruler, graph paper.

After completing steps 1 and 2 of scientific method:

a. Fill plastic box with an even 1-inch layer of sand. Tilt box at 30-40 degree angle using books.
b. Mix 1 cup of water and a few drops of food coloring in a jar, until the liquid is bright.
c. Note the time and slowly add 1/4 cup of the colored water to the top-center portion of the sand box.
d. In 2 minute intervals graph the process of the colored water by measuring the length and width of the plume and drawing it to scale on graph paper.
e. Add 1/4 cup more liquid after each measurement. Also record when it has seeped through to the underside of the tray.
f. Continue as time permits until liquid reaches low end of tray. Prepare more liquid if needed.
g. Compile and record your data and complete the last two steps of scientific method.

EXPERIMENT 2: Do Different Types of Soils Leach Groundwater at Different Rates?

MATERIALS: 12 clear plastic cups, 4 kinds of soil such as: sand, peat moss, garden soil, vermiculite (do not use clay-it takes too long), 8 flat wooden (coffee) stir sticks, water, food coloring, awl, paper towels, clock.

After completing steps 1 and 2 of scientific method:

a. Punch a hole in the bottom of 4 cups using the awl, (teacher may do in advance), cover the hole with one layer of paper towel to act as a filter, and fill each cup 3/4 full with one type of soil.
b. Fill 4 other cups with 3/4 cup of water and add a few drops of food coloring to each.
c. With the last 4 empty cups, lay two wooden sticks across the top of each. Carefully set the soil cups on top of the empty cups/sticks.
d. Record time and slowly pour the colored water into each soil cup simultaneously. Keep adding more water gradually until all the liquid is poured into the soil.
e. Make note of the time when: the liquid begins to drain into the empty cup; all liquid has been poured into the soil; the empty cup becomes 1/4 full; 1/2 full.
f. Compile all your data and complete the last two steps of scientific method.

EXPERIMENT 3: Does a Clay Liner Protect the Groundwater?

MATERIALS: ant farm or two plates of glass sealed 1/4 inch apart with a seam of epoxy, light colored sand, two straws with pin holes, food coloring, water, clay, needle/nail, 2 ft. siphoning hose (aquarium tubing works well), jar.

After completing steps 1 and 2 of scientific method:

a. Fasten the two straws with pin holes 1-2 inches from either end of ant farm. (May glue, brace or wedge the straws in place — Teacher may do in advance).
b. Carefully pour sand between the two straws until it is 1 inch from the top.
c. Roll a strip of clay and place it on top of the sand in a "dish" shape and seal it to the glass sides — simulating a landfill liner. Punch 1 or 2 small holes in the clay liner.
d. Pour water in one end of ant farm between the straw and the edge. To simulate groundwater flow siphon water from an elevated jar. (Place one end of hose in jar of water, draw the water to the other end of the hose by sucking, quickly transfer this other end into water of ant farm, keep both ends down in the water and water should be moving from jar to ant farm — you may need to try a few times).
e. Record the time & drip water dyed with food coloring into clay liner — add more holes if necessary.
f. Record the movement of the colored water, the direction, and the size of the plume(s).
g. Compile data and complete the last two steps of scientific method.

5. Creative Endings

ACTIVITY: Reading, writing, and class discussion
MATERIALS: Worksheet.
TIME: Homework and one class period.

As we become more aware of the toxic chemicals that exist in our homes, we must also face the dilemma of how best to dispose of them. This activity uses two scenarios to review proper disposal methods and examine how other people may feel about this information.

OBJECTIVES:

- Students will apply information about proper disposal methods to new situations.
- Students will encourage proper disposal methods & sensitivity to other people's ideas and feelings.
- Students will practice thinking and writing creatively.

TEACHER PREPARATION:

1. Duplicate Student Handout 5A.

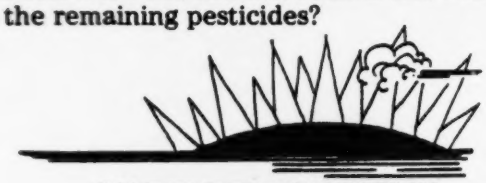
CLASS ACTIVITY:

1. Distribute the "Spring Cleaning & Summer Jobs" handout and ask students to complete it at home.
2. Next class session have your students brainstorm possible routes of disposing of household hazardous waste. What happens to the chemicals in each situation? Here is a partial list to complement their ideas:
   incineration: chemicals released into the air.
   storm drain: chemicals enter the wastewater system or are released into rivers or streams.
   pouring it on weeds: chemicals enter the ground and the groundwater.
   down the sink: chemicals enter the septic or sewage system.
   give it away: the substances are used up.
   recycle it: chemicals are reused in part or entirely for new products.
   landfill: chemicals are contained in a clay lined pit or leach into the groundwater.
   save it: until it is used up.
3. Ask your students to rate these methods. Is there one method that they think is the safest? Are some materials better suited to certain methods? Which might do the most harm?
4. Next have your students discuss why people may react negatively to this information. It is easy to criticize but one should also offer constructive methods of action. For example, Mrs. Parks may be unable to take the hazardous materials to a proper disposal site; Kurt and Dan could possibly do it for her. Or, they could help organize a community collection day.

FOLLOW-UP:

If you find that your students need additional work in divergent thinking, have them practice creating and solving their own story problems. Here is an example:

John Kind's farm has been plagued by insects every year for as long as he can remember. The insects destroy his crops and reduce the income he receives in a year. In anticipation of this year's pest, he purchased five gallons of the strongest pesticide he could find. However, this year the insects were not bad and John is left with four gallons of pesticides. What should he do with the remaining pesticides?



COMMUNITY COLLECTION

Many communities have begun to take steps towards management of locally generated hazardous materials. Community household collection programs, insuring that small amounts of hazardous wastes are treated (if possible), recycled, and disposed of properly, have been a great success throughout the country. In Cleveland, a community organization has arranged for a hazardous waste management company to accept wastes on specified days. Within one year, 20 55 gallon drums have been properly disposed.

STUDENT HANDOUT 5A

SPRING CLEANING & SUMMER JOBS

Directions: Read the following situations and answer the questions. Use the back of this sheet for additional space.

Mary and Jeff were just on their way out the door to play the first softball game of the season, when their mother caught up with them. She explained that it was time for the annual spring cleaning and she could really use some help. Mitt and bat aside, Mary decided to tackle the storage closet in the laundry room. She could never find anything in the closet. It was such a mess! Jeff, on the other hand, decided to clean the garage. Last year he had lost one of his best mitts and was never able to find it among the jars, cans, and boxes, his parents had stored there. At the end of the day they were both surprised to find...

1. List the hazardous materials that Mary and Jeff may have found.

2. What do you think Mary and Jeff should do with the hazardous materials they found?

3. Finish the story with your ideas.

Kurt and Dan knew that to purchase the new hockey skates for the next season they would have to work hard all summer. They decided to be self employed, doing odd jobs for people in their community. Ms. Parks, an elderly person, was their first employer. She asked the boys to clean up her yard, mow the lawn, and trim the shrubs. Kurt and Dan began their work behind the garage, but were unhappy with what they discovered: at least six open cans of partially used paint, one jug of antifreeze, which had been punctured, and a pan of used motor oil which Ms. Parks' son had left after he had changed the oil in her car. Kurt and Dan knew that this was no way to dispose of potential hazardous waste, so they decided to tell Ms. Parks of their discovery and recommend that she ...

4. If the waste is left untouched, what effect may these materials have on the environment?

5. How do you think Ms. Parks will react to Kurt and Dan's news? How do you think the boys should deal with a reaction that may be very defensive? unconcerned? appreciative?

6. What would you do to finish this story?

6. Test & Compare

ACTIVITY: Consumer product testing.
MATERIALS: Various cleaning supplies.
TIME: 1 & 1/2 class periods & out of class work.

As consumers, we often buy cleaning products based on convenience, price or advertising gimmicks. We have seen in other activities that many of these products become hazardous wastes in their production or disposal. An alternative to finding proper disposal methods for the vast amount of waste that we generate is to limit the amount of toxic substances we use. Do we really need the products we purchase? Are there non toxic alternatives? This activity is designed to show that simple, safer alternatives do exist. In a fun and constructive way, the students test and compare various cleaning products.

OBJECTIVES:

- Students will practice designing an experiment.
- Students will build observation skills.
- Students will record and analyze data in a systematic manner.
- Students will work toward developing a conscientious consumer ethic.
- Students will learn to accept other viewpoints representing different values.

TEACHER PREPARATION:

1. Review experimental design with students. Their home list of products (Handout 2A) may be useful in this activity.

CLASS ACTIVITY:

1. Have the class divide themselves into groups of four. Have each group choose a common household cleaning product that they would like to research(scouring powder, glass cleaner, etc.). They can return to their list of products from their home survey. (Handout 2A).
2. Introduce the idea of a product experiment; they might pretend to be **Consumer Reports**! Each group will design an experiment to test a type of household cleaner that can be run at school. They could use a glass cleaner on different classroom windows, tile cleaner on the floor, sink cleanser in the restrooms, etc. They should plan to include a non-toxic alternative product, several commercial preparations, and a control of their choosing.
3. After deciding on a product, each group should agree on the qualities of the product that should be measured. What criteria should they use to determine a *good* product? Cleanliness, aroma, price, elbow grease, toxicity, and availability may be considered. Along the same order, which variables should be controlled? Will the same student clean each item? Will the items be equally dirty in the beginning? It is important for the careful researcher to examine these questions before starting the process of scientific research.

4. The next step will be to create the data chart. How often will measurements be taken? How will quantities be measured? If the ideal instrument has not yet been developed and experimenters will need to rely on their own sense of cleanliness, the group may consider averaging their ratings.
5. Finally, the items to be tested should be brought from home, purchased, or mixed in the classroom. A few recipes are included below; the following fact sheet from the Council on Hazardous Materials in Cleveland, Ohio has been included for more examples.

FURNITURE POLISH

2 Tablespoons olive oil
1 Tablespoon white vinegar
1 Quart warm water

DISINFECTANTS

¼ cup bleach
1 quart of water

GLASS and MARBLE CLEANER

½ cup vinegar
1 gallon water

6. The next class period, each group should briefly demonstrate their experiment, explain their alternative product, and describe the item they would recommend for home use.

Discussion Questions:

1. Were they surprised at the number of products available for each purpose?
2. Do some products have advantages *and* disadvantages?
3. Which criteria were most important in their discussion?
4. Do they think that these products are necessary?
5. Were the alternative products satisfactory?
6. Will people realistically change buying habits? What could the class do to change consumer habits?

7. Gearing Up For Action

ACTIVITY: Discussion.
MATERIALS: Newsprint/blackboard.
TIME: 1 class period.

Most units need a review to remind students of the progress they made. This activity starts at that point, and goes on to list the types of concerns your students may choose to develop into a class project under the guidelines of Unit 5.

OBJECTIVES:

- Students will review the material covered throughout this unit.
- Students will develop integrative problem solving skills.
- Students will identify areas of interest for future projects.

TEACHER PREPARATION:

1. Obtain newsprint and markers for each group.
2. Review your class's performance throughout this unit.
3. As the students are developing their group plan, encourage them to use an integrative approach to solving the hazardous waste problem: consider the short term and long term, the total environment — urban and surrounding rural areas, who will be impacted by the plan, the technological and transportation constraints, the economic and political realities, and community support for the plan.

CLASS ACTIVITY:

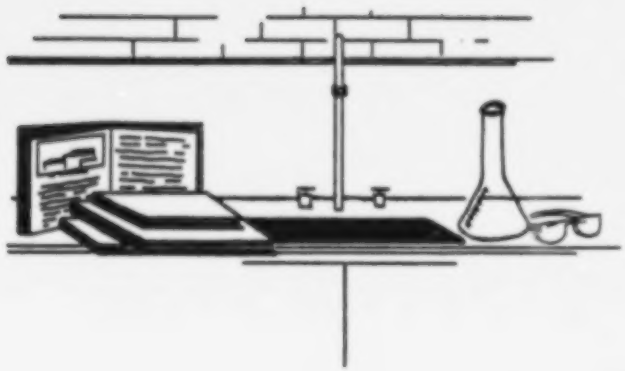
1. Ask the class to form groups of 5 or 6 and review the activities they have completed thus far: labeling and hazards in the home, disposal systems, groundwater contamination, alternative testing, etc.
2. If they were a Hazardous Waste Task Force for their community, what recommendations would they make for an overall city plan of household hazards: this might include education programs, new disposal facilities, regulations, incentives to use alternatives, etc. Allow 15-20 minutes to plan and write their ideas on newsprint.
3. Have each group submit their recommendations to the class. They should be prepared to explain why they selected this plan and what is the highest priority action to solve the problem.
4. As the ideas are presented, post their sheets of newsprint on the blackboard. Explain that these are projects that they might investigate further. If anyone claims that an idea is unreasonable for them to pursue, it may be scratched from the Action List. Ask if there are any other ideas that are not listed.

FOLLOW-UP:

At this point you may want to continue to Unit Three, examining school hazardous chemicals and policy, or Unit Four, which looks at the community. Each unit will build on the basic knowledge and principles achieved in this unit, while expanding your students' horizons. However, if the students are interested in following their ideas with an action strategy, turn to Unit Five to begin your community project! In any event, save the lists your class has generated in this unit to complement their ideas when you are ready to select a community action project.

Unit 3

Hazardous Materials in the School

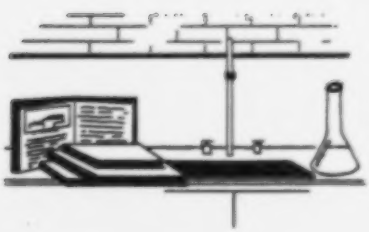


In today's schools, teachers and students utilize many chemicals, particularly in vocational, science, and art classes. Although our awareness of which chemicals are hazardous has increased, there are still many chemicals in schools for which the long-term exposure effects are unknown. Whenever these chemicals or their containers are discarded, they become hazardous wastes.

This unit will help your students cultivate a healthy awareness and concern for the management of hazardous chemicals within the school, from purchase and storage through use and disposal. Sparked by the scenarios that follow, your students may choose to help develop policies and recommendations for your own school. Feel free to alter the activities to suit your group, and to use activities from other units to answer questions. Unit 2 contains information on groundwater and Unit 4 has materials on various disposal systems that may help your students understand the complex issues that surround hazardous wastes.

	ACTIVITY	Page
1.	***Five Scenarios***	3-3
	Basic toxic issues in school	
	Handout 1A: Purchasing Chemicals	3-4
	Handout 1B: Ether it's Safe or it's Not	3-5
	Handout 1C: The Perfect Art Room	3-6
	Handout 1D: Prepared for the Worst	3-8
	Handout 1E: Down the Drain	3-9
2.	***Mapping the Territory***	3-10
	Survey of School	
3.	***Asbestos in the School***	3-12
	A Simulation	
	Handout 3A: Introduction to Asbestos	3-13
	Role Cards	3-13

1. Five Scenarios



ACTIVITY: Small groups of students will examine the scenarios and make recommendations
MATERIALS: Handouts
TIME: 2 periods

This series of case studies and examples will help your students understand the basic issues associated with chemicals in schools without actually hunting them up. If they are interested in their own school's policies, your students might play a leadership role in improving safety precautions.

OBJECTIVES:

- Students will use examples of other schools to gain an understanding of the dangers associated with hazardous chemicals in their own schools.
- Students will work in small groups to offer recommendations to the situations in the scenarios.
- Students will learn to present recommendations to a group effectively, possibly leading to the development of strong leadership skills or to recommending actual policy changes.

TEACHER PREPARATION:

1. Read over the five scenarios that follow this activity. Decide if you want every student to work on each scenario, or if each pair or group of students should address only one. Then duplicate the appropriate number of scenarios and discussion questions.
2. This activity is rich in follow-up potential. Think about your school and the personalities of the teachers that might be involved. If students would meet a brick wall trying to offer suggestions in a particular department, you may want to channel their discussion to a more fruitful avenue.

CLASS ACTIVITY:

1. Distribute the scenarios to pairs or groups of students and ask them to read the story and discuss the questions that follow it.
2. When the groups are done, invite them to share their recommendations with the class and lead a discussion about the advantages and disadvantages of different practices.
3. If the students set out to research their own school for similar scenarios, spend some class time discussing how others might feel about their questions and proper protocol when investigating school policies. You may want to discuss this activity with the administration and teachers and engage their cooperation before the students arrive.

FOLLOW-UP:

1. What recommendations do your students have for your school policies on purchasing, storing, using, and disposing of hazardous chemicals? (See Unit 5 to pursue this action.)
2. What process would be appropriate to present the recommendations effectively and implement a strategy which would actually result in positive change?

PURCHASING CHEMICALS

The telephone was ringing as Frank Patterson opened the back door. Laying the freshly picked peas aside and rinsing the garden soil from his hands, he grabbed the receiver on the fourth ring and said hello.

"Hello Frank, this is Cyndy Suttman. Did I catch you at a bad time?"

"Oh no, not at all. I just came in from the garden. How's your summer been? Did you get some good slides on that whalewatching trip?" asked Frank. He was hoping to use some of his teaching partner's slides in his unit on oceans.

"I have a great set of slides — although my stomach may get queasy again just watching them!" Cyndy said with a grin. "But I'm calling about the chemical order; if you want formeldahyde for the frogs in September, I've got to get this in the mail this week. I have last year's order in front of me — has anything changed for you?" As Science Chairperson one of her summer tasks was to complete the order for chemicals and equipment. As usual, it always got done at the last possible moment.

"I should have known you were calling about that order. Seems like the peas were coming on last year when we did this! At least one year we should get this done early. But in June we sure don't want to plan for September, do we?" admitted Frank. "I think you can reorder everything I used last year, but add some N-Butanol for the Amino Acid Chromatography experiment".

"Fine, that comes in three sizes." Cyndy commented as she read the order form. "Do you want..."

"Just give me the biggest one, that way we'll have enough to go around", Frank interrupted. "We might have some back on the top shelf, but I sure don't know how old it is, do you?"

Cyndy paused as she thought about that top shelf. "Well, no, I don't. I don't suppose any of the science teachers know about those chemicals, especially with all the assignment changes in the last few years. Given the piles of dust, it's been a while since those bottles have been moved. I wonder how to get rid of some of those containers."

"Well, when the School Board grants teachers a few paid working days to inventory our equipment and take care of such things, I'll be the first one in the storeroom to clean it up. But until then, those bottles will just have to wait because my garden comes first!" exclaimed Frank. He considered himself a good teacher, and a good person, but he wasn't about to be abused by a School Board that couldn't invest a little money in its staff.

"I guess the shelf will wait, then. Thanks for your help with the order, Frank. See you in September for a slide show." As Frank said goodbye and Cyndy completed the chemical order form, she wondered how many of the same chemicals they had left over from last year, and whether any of them were still useful. But, she was a biologist, not a chemist, and someone else would have to deal with the storeroom.

Discussion Questions:

1. What are your recommendations for Ms. Suttman about ordering chemicals, especially with regard to quantities, concentrations, and bulk orders?

2. What should Ms. Suttman say to Mr. Patterson about cleaning out the storeroom? What could they say to the administration or the School Board? Who might be able to help them?

3. How are chemicals ordered in your school? The art room, the science department, and the vocational shops (print, auto, metal, etc.) all use chemicals. Are chemicals easy to locate in the storeroom? Are chemicals used quickly or do some sit around for a long time?

Ether It's Safe or It's Not

'Hasn't that jar of ether been sitting in my attic for 20 years?"

by Jonathan M. Bealer

It all began with a television news item about a safety inspection team that discovered 9-year-old vintage ether on the shelves of a Tucson high school. The story showed some shots of the heroic Tucson fire department carefully carrying the deadly chemical in explosion-proof baskets while wearing fireproof metallic armor. The scene then switched to a garbage dump on the edge of town, where a great plume of dirt and smoke rose into the desert sky. It was a happily-ever-after ending: thousands of young lives saved; a great job done by the fire department.

As I watched, a dim memory began to surface. Didn't I once have a can of ether myself? The memory became brighter, began to take on definite shape. Yes—yes I did! In fact, I think I know where it is right now, and hasn't it been over 20 years since I got it? Old ether can form a class of unstable

compounds called peroxides whose oxygen-to-oxygen bonds are very touchy—like nitroglycerine, only more so.

Thoughts of my beautiful new house going up in flames pushed me into action. If my memory is right, I thought, the ether is up in the attic along with the rest of my old chemistry stuff. In the devilishly hot attic. Doesn't heat speed up reactions?

As I made my way up the ladder into the attic, I assured myself that I had probably thrown the stuff away already. I began to inspect some of the suspect cartons. At first my search proved fruitless. Then I came upon the ether, still in its little green box with "Unlawful to dispense without prescription" printed on the outside. I carefully lifted it out of the jumble of old beakers and ringstands, cursing myself for forgetting my flashlight.

My heart almost stopped when I heard a hissing sound. But it was only my arm rubbing against one of the box flaps.

Hissss . . .

My heart almost stopped when I heard a hissing sound. But it was only my arm rubbing against one of the box flaps. I allowed myself to breathe again. Gingerly, I placed the box next to the attic door. I crawled down onto the ladder and reached back for the ether. Keeping it level and trying not to tremble (too much), I climbed down.

Alone with the potential bomb, I let my imagination run wild. I could see pieces of the metal can, sharp as knives, flying through the air, spinning hideously. I put on some safety glasses. The next step? I had to take the can out of the garage, away from the house, where it wouldn't do much damage if it did explode. Should I put it in something? The closest thing at hand was a plastic bucket. I grabbed it, deciding it was better than nothing. Just as quickly, I had an awful thought: Which is worse—a shaky hand holding a can or a shaky hand holding a bucket with a can banging around inside?

I finally screwed up my courage, put the can in the bucket, and walked out the garage door. I looked at the bucket; it was definitely shaking. I listened carefully. Was the ether making some sort of fizzing sound? I decided to take it out by the trash barrel. I finally reached the trash barrel and placed the ether on the ground beside it. My neck and back felt as if they were made of rubberbands that had been wound up, tighter and tighter, until they were in big knots. What now? I certainly could not leave it there to face tomorrow's hot Sun.

Where's the fire?

Thinking back to the news story that had sparked my adventure, I decided to call the fire department. After all, they were the heroes who had disposed of the ether in Tucson. I found the number of our rural county fire department in the local phone directory. I could choose between the "to report a fire" number and the "all other calls" line. The young man who answered the "all other calls" line was pleasant enough. After I told my story, he asked me to hold. After a few minutes a second voice came on the line: "Well, I really don't know what to tell you. We don't have the facilities for anything like that. Here, let me give you the number of the local military base. Maybe they can tell you what to do."

I got the emergency number of the Explosive Ordinance division. It rang a dozen times before I hung up. Thinking I had dialed the wrong number, I tried again. After another dozen rings I gave up. Back to the fire department.

"They didn't answer? Well, I have this toll-free number for chemical emergencies. Let me give that to you and see what they can tell you," said the fireman, sounding very much like a salesman seeing what he had in stock on his shelves.

A man answered the phone, after only one ring. "Do you have a chemical emergency?" I was a little shaken. I didn't think I was in immediate danger of going up in flames. Was it really an emergency? "I think I have a chemical emergency," I said apologetically. "The local fire department gave me your number." After I told the story of the 20-year-old can of diethyl ether, he seemed to agree that there was indeed an emergency. I felt better already.

"Well, I can't help you much," the emergency-phone-answerer said. "You see, every state has different laws regarding the disposal of hazardous wastes. We can't advise you about how to get rid of it. I can tell you that the stuff is probably very dangerous. You're lucky you didn't blow your hand off. [The fingers of my right hand began to tingle as he spoke.] Has it crystallized? And I wouldn't advise you to shake it to find out."

I piped up, "Well, the seal has never been broken. Maybe it hasn't dried up." He would not relent: "If it's over 20 years old, I think you'd better assume that it has crystallized."

It was time to bring in the county sheriff, in a rerun of the fire department. After a "Hold on," a voice said, "I'm going to give you this number to call."

Back into their court

By this time, I was getting discouraged. I, who hate making calls more than I hate scrubbing the inside of a filthy garbage can, had already made four calls. Now they were asking me to make another.

The woman who answered at the sheriff's office took my name and address and put me on hold. She came back on the line to say they'd send somebody around soon.

Now I felt pretty good. I kept looking up the road to see if I could make out the sheriff's car. After an hour or so, the phone rang. (I carved a sixth notch in my phoneside pencil.) The sheriff's dispatcher said, "I've been told to instruct you to take care of your

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ether in the following manner: Bury it in a small hole until Monday. [Monday was 7 days away.] It should be safe until then. On Monday, call this number." I waited for an explanation. After an awkward pause, I asked whom I'd be calling. She gave me a man's name. I was too embarrassed to ask any more questions. Obviously, anyone who was anyone knew that name.

I carved a sixth notch in my phoneside pencil.

The county officials felt that they had given me a course of action. They, of course, didn't have to do the burying. I did not relish picking that thing up again to put it into a hole. I did not want to touch the bomb again, ever. Period. I decided to try the Explosive Ordinance division again. This time they answered the phone on the first ring. Again I told my story.

The response was, "We can't do anything for you as a private citizen. All we are empowered to do is to help out the civilian force if they don't have the facilities to handle it themselves." I told this latest voice that the fire department had told me to call. "If they were to request your help, would that be official enough?" I asked. It would be, the soldier said. The fire department would have to call, though.

Call number eight was easy. I told the fire department what the Army had said and gave them my name, address, and phone number, lobbing the ball back into their court. The end finally came when the phone rang again. It was the highway patrol to say they'd be out some time that evening. How they got in the picture I still don't know.

There is more to this story but I guess the ending is not really important in the grand scheme of things. However, it does point out a problem with living in a rural area. I suppose rugged frontier types are supposed to handle little problems like these alone, but I really don't believe that such a potentially dangerous situation is properly handled by the individual.

Although I didn't expect a bomb squad to rush over to my house, I do think that there should have been some sort of reasonable alternative in that vast network of public safety professionals. Buck passing is sort of cute, at first. But I shudder to think of what would have happened if this had been a more acute emergency.

By the way, does anyone know the correct way to dispose of potentially dangerous ether? ■

Dealing with peroxides

by Jay Young

There is no single right answer to Jonathan Bealer's question: What is the correct way to dispose of potentially dangerous ether? As he found out, his question is so novel that unless they have been asked it before, the "authorities" may not have a ready response. Each state handles the disposal of toxic or dangerous chemicals differently. In a school setting, it is likely that your school district has a plan for dealing with such situations. Check it out before you are in need of a quick answer.

The best way to deal with peroxide-forming compounds is not to get yourself in Jonathan Bealer's predicament—test your ether or other peroxide-forming compound every week for the presence of peroxide. If you find peroxide, reduce it; the amount of peroxide that forms in only 1 week is not likely to be hazardous.

There are several peroxide-forming compounds: any ether, such as diethyl ether, diisopropyl ether, and dioxane, and other compounds such as tetrahydrofuran, acrylic acid, and butadiene. Within the first week after you receive a peroxide-forming compound and every week thereafter, add 1 cc of the liquid to 10 cc of a freshly prepared 10 percent aqueous solution of KI, mixing well. A pale yellow (or deep yellow or brown) color that develops in 10 to 15 minutes or less indicates the presence of peroxide. Although false positives are possible, all positive results should be interpreted as indicating the presence of peroxide.

If only a barely discernible yellow color develops, the liquid contains peroxide at a sufficiently low concentration to be reduced. To reduce the peroxide, prepare a solution of 100 g $FeSo_4$ in 85 mL of water and 42 mL of concentrated hydrochloric acid. Add the ether or other compound to this solution and mix (shake) well. Separate the two layers and again test the treated ether for peroxide. No color will develop if the peroxide has been reduced.

Some suppliers of ether and other peroxide formers add a peroxide inhibitor to their product and print a "Do not use after [date]" warning on the label. On or after that date, peroxide will form. Except for date-labeled containers, never open a container of a peroxide former to test for peroxide if you received it from the supplier more than 6 weeks ago. In little more than 6 weeks, some peroxide formers—even when in an undisturbed, closed container—can develop peroxide in amounts sufficient to explode if you move the cap even slightly.

Liquids less than 6 weeks old that test deep yellow or brown should be destroyed immediately. If local environmental regulations—and common sense—permit, quantities up to 500 cc can be destroyed by biodegradation. Pour the liquid on several square meters of soil in a location where you know the area will not be disturbed in any way until after the liquid has completely evaporated.

All *undated* containers of peroxide-forming substances received from the supplier more than 6 weeks previously and all containers of unknown or incompletely known history should be considered to contain peroxide and to be extremely hazardous—capable of exploding when the container is moved as little as 1 mm in any direction. (Jonathan Bealer is a very lucky man.) Do not ever, under any circumstances, open, move, or even touch a container of ether on your shelf that is past its expiration date. In such cases, clear the entire area of people and summon a disposal expert.

Jay Young, chemical safety consultant, 12916 Allerton La., Silver Spring, MD 20904.

ETHER IT'S SAFE OR IT'S NOT

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Discussion Questions:

1. What should the author have done when he discovered the old ether?

2. Considering the difficulty the author experienced in solving his problem, what suggestions would you have for a more efficient system to help him?

3. What agencies/individuals, which are present in your community, could have assisted the author?

4. What other agencies or individuals could he have called?

5. Here are some potentially explosive chemicals; do you have any in your house?
   - benzoyl peroxide
   - carbon disulfate
   - diisopropyl ether
   - ethyl ether
   - picric acid
   - perchloric acid
   - potassium metal

6. Are any of these chemicals stored in your school?

7. What might you recommend to your school about the safe removal of these potential bombs?

THE PERFECT ART ROOM

"If I've told them once, I've told them a thousand times, Crystal. What should I do with those few students who won't think about the hazards of the chemicals in the art room?" muttered LaMont Roberts. He was in charge of the Art Room at Central High School, and had spent considerable time impressing students with the need for safety precautions and care with the toxic substances in his room. Even though most students understood his message, there were a few irresponsible ones who caused him to worry this evening.

"Well you can't fix it tonight," his wife assured him. "Why don't you just sit down and relax with the kids. The Cosby show comes on in a few minutes."

Agreeing with Crystal's wise advice, LaMont settled into the armchair as his two youngsters turned on the television. The chair was so comfortable that instead of hearing the opening strains of the show, LaMont found himself dreaming of school — the bell was ringing and his first hour art class students were filing in.

"Morning Mr. Roberts. This is Sandy, a new student. He had pottery at his old school and knows how to throw pots. Can I show him our kiln and the wheels?" asked a helpful junior.

"Welcome to Central, Sandy. I'll catch up with you in the pot shop, and thanks for taking care of his orientation, Jim," said Mr. Roberts. He was pleased with the initiative and the thoughtfulness Jim showed.

The students hurried to set their books out of the way of their art work and to retrieve their projects from the cupboard. They went about their business in a quiet, efficient manner. Mr. Roberts noted that the students who were soldering jewelry donned their safety glasses and wore protective aprons.

"Oops, what happened?" exclaimed Mr. Roberts as he heard a crash. Jim hurried to help another student mop up the cobalt glaze from the floor as Mr. Roberts rounded the corner.

"I think we've got everything under control, Mr. Roberts. The cobalt glaze jar fell out of my hand, but we're wiping it up. I'm glad you put it in a plastic container, or we'd have glass shards to clean up, too," said the student. "I'm putting the cleaning rags in the rag bin marked 'Toxic,' is that right?" he asked.

"You remembered correctly — cobalt is a heavy metal and those rags shouldn't be rinsed in the sink or washed with the regular rags. Good job." Mr. Roberts was very pleased with the attention to detail required for even the simplest thing — cleaning up a spill.

Mr. Roberts continued around the room, offering help and advice to his students. He came upon an unfinished project and asked a neighboring student who was working on it.

"Oh that's Maria's sculpture, and she'll be back. She was real hungry and went over to the time-out area to eat an apple," answered Maria's friend. "By the way, I put a bottle with a rusty lid on the 'Attention Please' shelf — isn't that what you told us to do?"

"Perfect," remarked Mr. Roberts. "Thanks for your help. I'll find a new container over lunch-time. Those rusty lids can contaminate the chemicals and make it difficult to open the bottle. We wouldn't want anyone spilling etching acid on their clothes."

Resting on the ledge under the poster reminding students of emergency precautions for spills and splashes, Mr. Roberts looked over his classroom. In every corner, students were busy with their own projects, or helping each other with an awkward, two-person task. The chemicals and equipment were clean and in their proper places, and students were working carefully with them. The students mixing clay were even wearing respiratory masks! No one enjoyed wearing those! Somehow, overnight, and as if by magic, his classroom was transformed. It was possible for his students to learn about safety procedures and to abide by them. Suddenly, he felt a tug on his arm.

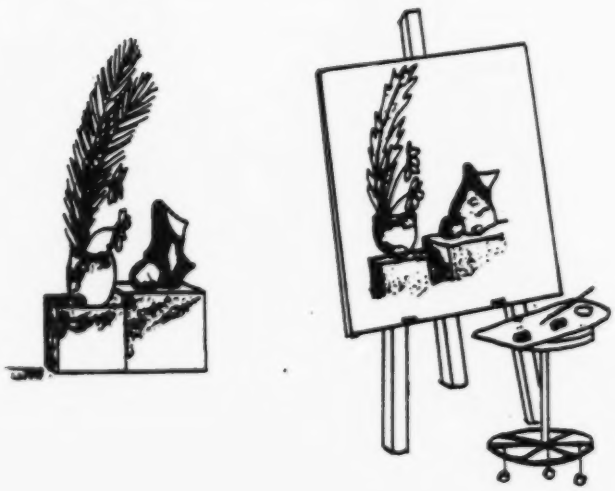
"Come on Dad, you promised a bedtime story," wailed his 6-year old son. "Can I have my story now?"

Mr. Roberts struggled to wake up. "What a dream!" he told his family. "My students did everything just as I hoped! And yes, now is a great time for your bedtime story, which one will it be?"

"What would happen if you shared your dream with your students. Do you think they would believe that a 'perfect' art room were possible?" wondered Crystal as LaMont headed up the stairs. "It's worth a try," he called back in response.

Discussion Questions:

1. Make a list of all the good practices that showed the students being careful around hazardous chemicals and potentially dangerous situations.
2. Add any ideas of your own to this list of "good behaviors" for an art room.
3. How might Mr. Roberts help his irresponsible students learn these "good behaviors"?
4. What would you recommend for good art room practices?
5. What practices are normal in your art room?
6. What recommendations would you have for your own school?



PREPARED FOR THE WORST

It was difficult to keep the students' attention on this first day of classes, but Mr. Andrews knew that this would be one of the most important lessons of the year. To get the students' attention, he began with some true stories he had heard at a laboratory safety workshop over the summer vacation. He asked the students to think of safety measures that could have prevented these accidents and injuries:

- Ms. Henson, a high school biology teacher, was demonstrating a dissecting technique on a clam prior to her students' clam dissection lab. A piece of tissue (from the "killer clam") flipped into her eye. Her eye was badly burned and her opthalmologist treated and bandaged it for two days.

- Part of Chris' on-the-job training included washing the dishes in the laboratory. She remembered Mr. Smith's instructions always to wear goggles, but she chose not to wear them because other workers never wore their goggles and she didn't want to be different. She was just beginning this task one day, when an unmarked, closed plastic container exploded as it was uncapped in the dishwater. It blew strong base into her eyes and onto her arm and hand. She was wearing neither gloves, a lab coat nor an apron at the time. Her injuries were treated at the local emergency room. Fortunately her eyes were saved. Her arm and hands had second degree burns.

- Mr. Peterman was demonstrating evaporation to his middle school class. He evaporated 50 ml of alcohol from an open beaker on a ring stand over a bunsen burner. His students gathered around the demonstration table to see it again. Mr. Peterman took the bottle of alcohol and poured out an additional 50 ml into another beaker. He set the open bottle on the demonstration table and proceeded to pour the 50 ml of alcohol into the other beaker which was still being heated. The alcohol evaporated very rapidly and exploded. In the excitement, one of the students knocked the open alcohol bottle off the table further fueling the fire. Several students were seriously injured and one was in the hospital for many months.

- Ms. Martin demonstrated the ammonium dichromate volcano as she had many times before. This time when she added alcohol as an ignitor, the volcano blew up. Ms. Martin was not injured but several of her students were.

By this time, Mr. Andrews certainly had his students' attention. He pointed out that some of these situations seem rare and unpredictable and this is exactly why all precautions should be taken, no matter how simple an experiment seems.

Discussion Questions:

1. What safety precautions might have prevented the injuries in each of these accidents?
2. Does your chemistry class have such precautions as "standard procedure"? Why or why not?
3. What emergency measures should be used when accidents like these occur?
4. How should uninjured class members react in an emergency?
5. What kind of safety and emergency equipment is available in your school's laboratories? Who is responsible for making sure that all of the equipment is working and in its proper place?
6. Why might a student be tempted not to use safety equipment? Is this ever advisable?

Senario 5: **STUDENT HANDOUT 1E**

DOWN THE DRAIN

The High School Auto Shop was a whirlwind of activity. By the end of every week, customers and their cars piled up; everyone anxious for the work to be done before the weekend. This Friday was particularly bad, as it was the start of a three day weekend. Most of the cars in the shop were in for minor adjustments and check-ups; Mr. Garcia knew his students could finish them by 5:00 that night. He circulated through the stalls, helping students and offering suggestions for time-saving short cuts.

In saving time, however, he refused to let the students become careless. An Auto Shop is a regular chemistry lab, complete with strong battery acid, potent degreasers, paints, oils, and toxic fumes. He regularly made sure that students deposited waste liquids in the proper containers and dropped their aprons and rags in the bin designated for the laundry that handles toxic residues on fabric. Two students were responsible for calling the waste haulers when the containers filled up and for seeing that the used motor oil was recycled. Mr. Garcia checked to make sure these containers were not overflowing.

In the back corner of the shop, two students were hurrying to finish an oil change.

"Come on, the owner is waiting outside for this car!" urged Sam. "We've got to clean up this station, too."

Sam's partner, Mel, worried about how they would get it all done. "But we've got to put the oil in the recycle drum, the transmission fluid in its container, and pour all the oil in the car!" he exclaimed.

"Look," demanded Sam. "There's simply not enough time." He grabbed all the rags and papers in a big pile, loaded them into the trash barrel, and dumped some of the waste fluids on top. Turning his back toward Mr. Garcia, he quickly poured the remaining liquids down the floor drain.

"There," Sam said with a note of finality in his voice. "That's all taken care of. You start up the car and back it out."

Discussion Questions:

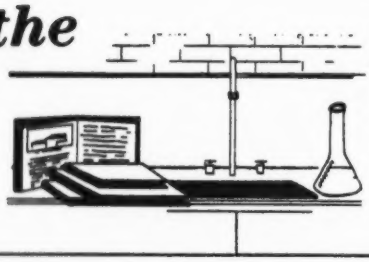
1. What will probably happen to the toxic chemicals in the waste liquids once the trash barrel is dumped? Is this a potential problem?

2. What should Mr. Garcia do to help students manage their time to be able to deposit their wastes properly?

3. What would you recommend as a standing waste procedure for this Auto Shop?

4. What is the procedure for getting rid of toxic chemicals in the Auto Shop in your school? What changes could you recommend?

2. *Mapping the Territory*



ACTIVITY: Small group survey of school chemicals
MATERIALS: Map, permission to talk to teachers and students around school.
TIME: Two periods

If your students are anxious to apply their new awareness of hazardous chemicals and wastes used and generated by their school, they will need to complete a survey first. This activity will help students systematically determine the chemicals and policies in their school.

OBJECTIVES:

- Students will brainstorm a list of potential sites for toxic chemicals and hazardous wastes in their school.
- Students will analyze the most appropriate ways to find out information that might be of a sensitive nature.
- Students will develop group and communication skills.
- Students will research information about the chemicals they discover.
- Students will use the standard school policies about ordering, storing, using, and disposing hazardous chemicals to evaluate their effectiveness.

TEACHER PREPARATION:

1. This activity is not appropriate for every class, every school, or every department. Think carefully about your school and your teaching colleagues. Should you modify this activity to look only at one component of the school? Check with the teachers in the department to obtain their cooperation before introducing the idea to your students.
2. Read over Activities 5 and 6 in Unit 5, ***How Do Others Feel?*** and ***Community Sensitivity*** and modify them to fit your situation. They should help your students develop a sense of asking the right questions and not playing investigative reporter or FBI!

CLASS ACTIVITY:

1. Make sure the students in your class understand the potential hazards associated with the ordering, storing, using, and disposing of hazardous chemicals in the school. Use the ***Five Scenarios*** activity and information on Groundwater, Landfills, and Wastewater Systems if the students need more information.
2. Ask your class to brainstorm a list of all the possible places hazardous chemicals may be used or stored in your school. Don't forget the vocational classrooms, the custodian's closet and maintenance shop, the art room, and the science labs.
3. If possible, have the class divide itself into small groups to survey each of these areas in your school. They should prepare to go on a mission to collect information, not to change opinions or practices (for now, at least). Do chemicals appear well labeled and organized? Is the purchase date legible? Are directions for emergencies apparent and easy to follow? Do students have access to these chemicals?

   You may have an art major who would feel very comfortable tackling the art room, for example, and would know enough about the containers to do the job quickly. You may not have access to the entire school, like the chemistry storeroom, for instance, but that shouldn't matter. Use your best judgment, and help the students project the consequences of this survey so that they practice making realistic, common sense decisions.

As the students discover certain chemicals and question their toxicity, introduce the Material Safety Data Sheets. One is included in this activity as a guide. These sheets should be sent with every order of hazardous substance directly from the company. They are an excellent reference to the chemical nature of the substance and its safe storage, handling, and disposal. Most of the students' questions should be answered from these pages.

4. For each area of the school, have the groups ask the teacher or staff person who works there about the policies or standard practices that govern how the hazardous chemicals are ordered, stored, used, and disposed. Have they developed a formal system? Does one teacher handle everything that is hazardous? Are the students allowed to use the materials? Is their training adequate? How often are the wastes disposed? Is there something that the teacher/staff person would like to change about this policy?

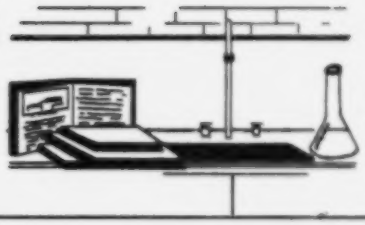
   OPTIONAL: Depending upon the school, you may feel more comfortable asking one teacher who has responsibility for hazardous substances to come into your class to describe the procedure used in their department. If this teacher would like to change the practice, he or she may enlist the energy and support of your students.

5. With the information the students have collected, lead a discussion that covers each area of the school. You may wish to use a map of the school to illustrate areas with no chemicals, low concern, medium concern, and high concern. Students can define "concern"! Review their data and analyze the effectiveness of school policies What recommendations could your students make for your school?

FOLLOW-UP:

The recommendations your students have formulated could be pursued; would they like to see to see them implemented? Unit 5, the **Community Action Project**, provides a set of guidelines to help you and the students develop a project and take action to improve the issues they identified with hazardous chemicals in their school. Skip directly to Unit 5 and use the most appropriate steps and activities for your new project!

3. Asbestos in the School



ACTIVITY: Small group discussions and roleplay
MATERIALS: Handouts, paper, pencils
TIME: One class period

Many schools that were built with standard insulation between 1940 and 1979 may have asbestos in the ceilings. It was used as a fire retardant, insulator, and sound deadener. Asbestos can break into tiny fibers that are easily inhaled or swallowed. These asbestos fibers have been proven to be carcinogenic. In this simulation, your students will decide if the school should remove or seal off the asbestos insulation, or make no effort to interfere with the substance.

OBJECTIVES:

- Students will understand the typical concerns of several parties involved in asbestos removal in schools.
- Students will learn about asbestos, the dangers, and the precautions that are being taken in schools.
- Students will develop negotiation and communication skills.

TEACHER PREPARATION:

1. Make enough copies of Handout 3A for each student, and copies of the role cards so that every six students will have one set.
2. Find out about the asbestos situation in your school. Has there been a competent inspector? If asbestos has been found, has it been removed? At what cost? Are there any pending actions?

CLASS ACTIVITY:

1. Introduce the topic of asbestos insulation in school buildings, distribute the introductory handout, and ask the students to read it the day before the simulation.
2. Divide the class into groups of 6 and give each group a set of role cards. Every student will play one role and contribute to the decision their group will make.
3. Give students 20 minutes to explain their views to their group, to make a decision, and to list 3 good reasons for their decision.
4. When all the groups have arrived at a decision, lead a full class discussion about their recommendations, their reasons, and the process they used to arrive at their decision.

FOLLOW-UP:

1. Does your school have asbestos? Do any large buildings in your community have asbestos? Is anything being done to remove the threat of asbestos exposure?
2. Where does asbestos go when it is "removed"?

INTRODUCTION TO ASBESTOS

Asbestos is a common name for several natural minerals that separate into very thin, strong, microscopic fibers. Asbestos was widely used between 1940 and 1979 for fireproofing, insulation, and sound-deadening in large buildings and schools.

When asbestos is **friable**, it crumbles easily. Unless it is sealed or encased, friable asbestos can break into a dust of tiny fibers that are easily inhaled or swallowed. Asbestos can also be **non-friable**, in which case it is not dangerous until it changes to friable.

Two types of asbestos insulation were used. It was either sprayed on in a loose, fluffy insulation or packed on in a wet mixture similar to cement. The fibers may come loose from the sprayed insulation unless the insulation is encased. The wet-applied asbestos is not likely to create a hazard.

When the tiny friable asbestos fibers enter the lungs or the stomach, they can lead to a severe lung disease (asbestosis), or a cancer of the lining of the chest and intestinal tract (mesothelioma), or lung cancer. Because of these dangers, many schools are removing or sealing off their asbestos insulation, even though it is very expensive. Schools with wet-applied or non-friable asbestos usually do not seal off their insulation as the risk is not as great.

In this scenario, assume that non-friable, sprayed insulation was used to build your school, but the extent of the insulation is unknown, and the length of time before the non-friable changes to friable asbestos is not known. Each of the people in your group: a parent, a scientist from the Environmental Protection Agency, an asbestos removal worker, a teacher, a School Board representative, and a principal, have an opinion to share about whether or not your school should spend the money to remove or seal off the asbestos.

ROLE CARDS

Parent

You are most concerned with the health of your child. The potential dangers of asbestos exposure are too great to risk the life of your youngster. You don't care about the costs of removal or encasement, and think the school should apply for an EPA grant to pay for it. Further, you think the students should be moved to another section of the building or another school until the asbestos is removed or encased.

Principal

You are concerned for the students' safety, but because the asbestos is non-friable, you do not think they are in immediate danger. In fact, tampering with the asbestos may be the worst thing; it might set some fibers free to drift around the school. Therefore, the students should not be in the schools during the removal process, unless the asbestos area of the school can be sealed off from the other side. Your main responsibility is the smooth running of the school. You would like to wait for an EPA recommendation, and carefully monitor the asbestos, taking action only when it shows indications of crumbling.

Asbestos Removal Worker

You work for a company that removes and encases asbestos in older buildings. You handle asbestos every day (wearing protective clothing and a mask, of course), and you know how dangerous it is when it becomes crumbly. Hence, your company's policy is to remove or encase even the non-friable asbestos, before it becomes dangerous. With regard to the sprayed insulation, you recommend removal rather than encasing it. If it were encased, sections of the sealed asbestos could still break away, exposing more fluffy fibers underneath. When you remove asbestos, you are very careful to seal the area from the nonaffected section, remove all light fixtures, furniture, drapes and other surfaces that may retain fibers, and cover carpets. You spray paint the area from which the insulation was removed, and you clean all surfaces very thoroughly.

School Board Representative

You are responsible for the budget for the schools, and there's not a lot to go around. You have an elected position, so it is also important to keep the voters (mostly parents) happy. You also try to work closely with the building principals to make their job easier. At this time, you favor no action on the insulation, because the non-friable asbestos has a very low possibility of causing health damage, you don't want to cut music and sports programs to pay for the removal, and moving students from building to building would interfere with their education. You would like to monitor the area carefully, and consider removal when the building is renovated.

Scientist with the Environmental Protection Agency

You cannot tell the people in this community what to do, but you can offer the latest research information about asbestos. Here are the facts, as you know them:

Friable asbestos can cause asbestosis, mesothelioma, and lung cancer. The asbestos in the school is non-friable, and it won't be dangerous until it becomes friable. There is no way of predicting when that could be.

The Environmental Protection Agency grants funds to schools to remove or encase asbestos, but only for friable asbestos.

Friable asbestos fibers are only detectable with a special monitoring program and an transmission electron microscope. One sample costs $500.00.

Teacher

You teach in a room that was identified in the asbestos area. You are very concerned about your health, and also about your students' health. You would like to see the asbestos removed (if that doesn't make matters worse), and if that is not possible, you would prefer teaching in a different room. You are in favor of frequent samples in the room to detect changes in the level of asbestos fibers.

Unit 4
Hazardous Materials in the Community

The hazardous materials problems that attract front page headlines rarely involve toxic substances from a household or a school. Big news events are often the result of mismanaged industrial waste, controversial disposal options, or accidents. This chapter will help introduce aspects of these issues through simulations, readings, group problem solving, and research questions.

To supply our society with the goods and services that we enjoy, industries, small businesses, farms, and repair shops across America use chemicals and produce hazardous wastes. Recognizing that hazardous wastes are everyone's responsibility is an important concept in this chapter. Knowing how these wastes are transported, stored, and disposed in your community can help your students make informed decisions about human health and safety.

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1. Hazardous Waste Card Games

ACTIVITY: Several small group games.
MATERIALS: Handouts
TIME: 15-45 minutes

When difficult problems arise, it is handy to have a "them" on which to pin the blame. The chemical industry often shoulders this load, even though hazardous wastes are generated in the production of very common products that we want to purchase and use. These card games help students explore the production history of everyday items and the contribution these items make to the hazardous waste story.

OBJECTIVES:

- Students will be able to explain the association between common products and hazardous wastes.
- Students will expand their sense of responsibility for hazardous waste problems, after understanding the role they play as a consumer.
- Students will appreciate that the hazardous waste problem is not hopeless, if useful technologies and responsible industries make changes, and consumers are willing to pay the price.

TEACHER PREPARATION:

1. Review the Student Handouts for this activity.
2. Read over the following card games and decide which would best suit your students, or make up your own.
3. Prepare the necessary materials, and mark the cards if necessary.
4. Read over the Teacher Background section. It identifies some of the reasons and ways hazardous wastes are associated with these items. You may wish to distribute this to your students after the game.

GAME 1:

Object: Each player tries to collect the lowest number of hazardous wastes associated with three common items.

1. Give one person in each small group of 4-5 students one set of unmarked cards, the Scorekeeper's Reference Chart, and a piece of paper to record the group's score. This person will be the scorekeeper.

2. The Scorekeeper distributes 3 cards, face down, to each player.

3. Looking only at their own cards, the players decide (or guess) which items produce the least hazardous waste through their production. They are attempting to end the round with as little hazardous waste as possible. Each player may discard up to 3 cards, each time choosing a new card from the deck. After three rounds of discard options, the scoring begins. (Discarding is not required.)

4. Each player reads his or her items to the scorekeeper. The scorekeeper notifies the player of the hazardous waste for which that item is responsible, and notes these amounts on the talley sheet, by waste type. After the player reads all three items, her talley may be "2 solvents, 3 other oils, and 5 pesticides/fertilizers." Option: each player can compute his own score from the reference chart.

5. After one round, groups may wish to discuss what was a surprise, or ask how certain items are responsible for particular wastes (see the Teacher Background on Hazardous Roots).

6. Try another round, trying to tally the lowest number of hazardous wastes.

GAME 2:

Object: Students are given cards with information about the wastes associated with these common items, and try to figure out the types of wastes that are produced and the relationships between the items.

1. Distribute one set of marked cards to each group of 3-4 students. On the back of each card, make a colored mark for each type of hazardous waste associated with the production of that item. (See Scorekeeper's Reference Chart.) Make all the marks for any one waste the same color. For example, if you choose green for pesticides/herbicides and blue for other oils, a gallon of milk will have a green and a blue dot.

2. Ask students to determine the types of wastes indicated by each color, given their set of cards.

3. If this is too hard — give your students the option of asking you Twenty Questions, while you have the Information page! Remind them that you can only answer yes and no questions.

GAME 3:

Object: Rank a set of cards from smallest to largest contributors of hazardous waste.

1. Give a group of students an unmarked set of cards. Let them know that most items produce hazardous waste through their production process, and ask them to rank all of their cards according to how many different types of waste it typically generates. The items in the set generate from 0 to 5 different types of waste.

2. Giving them a reference chart, ask students to determine the "right" answer.

3. Ask if they have any questions or surprises with regard to their ideas about the ranking.

FOLLOW-UP:

1. Help your students understand that although everything may contribute to hazardous wastes, that does not mean we shouldn't purchase some things. When possible, however, we can choose to reuse items (plastic bags, used books, recycled paper) or purchase items that will be used many times before they are finally discarded (razor, refillable containers). Consumer choices between two fairly equal products can be made on the basis of which one produces less hazardous waste, which one was made in the U.S.A., which one decomposes first, which one used less energy to produce or transport, etc. See the Bright Spot UNNECESSARY NECESSITIES, in this unit.
2. Explore the toxic history of the products made in your area.
3. Discuss the relative toxicity of various chemicals — properly used herbicides are usually not as much of a problem as strong acids or metallic liquid wastes.
4. Research alternative products which may not generate as much hazardous wastes and still serve the same purpose (e.g refillable pen vs. disposable pen, wooden pencil vs. plastic marker, organically grown food vs. highly processed food).
5. Activity 2 in this unit: Baker's Dozen.
6. Help students research the production process of common items to determine other sources of hazardous waste.

HAZARDOUS ROOTS TO COMMON PRODUCTS

TEACHER BACKGROUND

1. Everything that is made of plastic or similar synthetic material comes from the petrochemical industry, and has as waste products:

solvents
other oil products

The items in the card game that contribute to these wastes are:

bag of chips—the bag is plastic
canvas tennis shoes—the rubber soles are synthetic
felt-tip marker—the plastic holder for the pen
gallon of milk—the gallon jug is plastic (even the cardboard containers are plastic-coated)
record album—the vinyl for the record is a petroleum product
polyester shirt—polyester fibers are made from petroleum

Several items that do not contribute as large an amount of plastic to this waste stream but are still significant:

plastic cover of the 3-ring binder
plastic rings that hold pop cans together
solvents in the wood finish on the guitar

2. Inks and dyes have an oil or solvent base, and often contain heavy metals for color (cobalt glaze becomes deep blue after pottery firing).

cotton shirt—the material dye
felt-tip marker—the ink
paperback book—the ink on the pages
polyester shirt—the material dye
wool sweater—the wool dye
record album—the cover is printed

These items also have dye or ink associated with their production. But either because they produce less waste, or because they can be used over and over again, they do not show up on the score chart:

canvas tennis shoes
library book
ticket to a concert

3. Most everything that is grown in this country (except organic food) involves the use of pesticides and fertilizers. Although fertilizers are made from petrochemicals, they are not "counted" twice. Pesticides are highly toxic poisons, designed to kill plants or animals, and produce a variety of wastes. Leftover chemicals and empty containers should be carefully disposed.

Bag of chips—potatoes, corn, or wheat
Canvas Tennis Shoes—canvas is made from cotton
Cotton shirt—cotton plant
Frozen pizza—wheat, tomatoes, grain for the cow or pig (cheese, meat)
Gallon of milk—the cow eats corn and soybeans grown with chemicals
Sack of apples—chemicals keep the insects from eating apples, and may control ripening times
8-pack of soft drink—the sugar
Wool Sweater—feed for the sheep

To a lesser degree, all of our wood products also contribute to the pesticide and fertilizer waste, because the timber industry grows trees very intensively.

pencils, record album cover, paper, paperback book, library book,
sack for the apples, box for the pizza, ticket to the concert, wood for the guitar.

4. Products made from metals generate metallic wastes and often corrosive solutions — acids and bases with metal impurities..

3 ring binder
Pencils
Cans of soft drink

In addition to these items, paper processing and leather tanning generate metal and acid/base wastes.

5. The double x's on the Scorekeeper's Reference Chart indicate a substantially greater amount of this type of waste—usually from two major components of the product. For example, the polyester shirt contributes wastes from the nylon fibers and from the dyes: two sources of hydrocarbon solvents.

6. Solvents are used to clean all machinery, therefore anything that is made with machinery has solvents as a waste.

STUDENT HANDOUT 1A

GAME CARDS

Wool Sweater	**Cotton Shirt**	**Polyester Shirt**
Library Book	**Paperback Book**	**Gallon of Milk**
Canvas Tennis Shoes	**Record Album**	**Three Ring Binder and Paper**
Bag of Potato Chips	**Leather Sandal**	**Pencils**
8 Pack of Soft Drink	**Felt-tip Marker**	**Frozen Pizza**
Guitar	**Ticket to a Concert**	**Sack of Apples**

STUDENT HANDOUT 1B

SCOREKEEPER'S REFERENCE CHART

Product	Heavy Metals	Acids & Bases	Solvents	Other Oils	Pesticides & Fertilizers
Bag of Chips			x	x	x
Canvas Tennis Shoes			x	x	x
Cotton Shirt			x		x
Felt-tip Marker			x	x	
Frozen Pizza			x		xx
Gallon of Milk			x	x	x
Guitar			x		x
Leather Sandals	x	x	x	x	
Library Book			x		x
Paperback Book	x	x	x		x
Pencils	x		x		x
Polyester Shirt			xx	x	
Record Album			xx	x	x
Sack of Apples			x		x
Ticket to a Concert			x		x
Wool Sweater			x		x
3 Ring Binder/ Paper	x	x	x	x	x
8 Pack of Soft Drinks	x		x		x

2. Baker's Dozen

ACTIVITY: Individual reflection on the value one places on common products
MATERIALS: Paper and pencil for each student
TIME: 1 class period

Many environmental issues cannot be resolved until people understand how their behavior contributes to the problem, reflect on their values, and make an effort to change their practices. This activity will help students clarify their values about synthetic material goods.

OBJECTIVES:

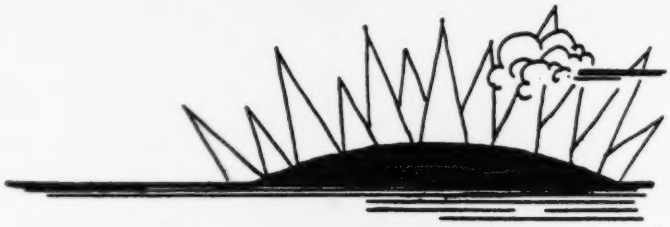
- Students will realize that consumer habits help contribute to hazardous waste problems.
- Students will contemplate the value they attach to items that are responsible for the generation of hazardous wastes.
- Students will consider altering their habits to reflect their increasing concern for the environment.
- Students will learn to listen to differing values, respecting viewpoints other than their own.

TEACHER PREPARATION:

1. Review the hazardous by-products generated by common items, such as those described in the Teacher Background section in the previous activity, ***Hazardous Waste Card Games***.
2. This activity will be most successful if students already feel comfortable talking with classmates about their feelings and opinions. If not, you may want to save this activity until the group has completed more group process activities, or alter it.

CLASS ACTIVITY:

1. Ask each student to list thirteen non-food items that they buy, use, or wear throughout the year on a piece of paper. Give them plenty of time to come up with their list.
2. Now, ask them to categorize certain items on their lists:
   - Choose two things on their list that they consider to be essential necessities, and draw a line through them.
   - Draw a line under any item that is used frequently for several years, like a soccer ball or trumpet.
   - Star any item made from petrochemicals (plastic, rubber, nylon).
   - Star any item that is artificially colored, bleached, or dyed.
   - Circle any item that is new to them — something that would not have been on their list five years ago.
3. Help students categorize any items that do not fall neatly into a section, or make up new categories to accomodate them.
4. Explain that most, if not all of the items on their list generate hazardous waste in their production. Knowing that they are responsible for part of the hazardous waste in the country, lead a discussion:
   - How do your students feel about their list?
   - Do they find any surprises?
   - Do they feel guilty? Angry at not having good choices?
   - Do they still *need* all the items on their list—are there some they might be able to do without? Are there alternatives that may not generate as much hazardous waste? Items made from natural materials or with less processing often fall into this category.
5. Ask the students to rank the underlined, starred and circled items on their list from 1 (the most important item to keep) to 11 (the least important, or easiest to replace). Ask if anyone plans to commit their concern for clean air, water, and soil to action by trying to change their habits. Introduce the idea that as long as people continue to buy these products, companies will continue to make them. It's up to us.
6. How can the class promote more responsible consumer habits amoung fellow classmates in the rest of the school?



UNNECESSARY NECESSITIES

"Civilization is a limitless multiplication of unnecessary necessities."

—Mark Twain

Now that the consumer connection has been made, how can it be resolved? The difficult choice of one product over another is often not enough. There are some additional questions we can ask.

Do I really need this product?
It is amazing how many items we can say "no" to without affecting our comfort, health, or enjoyment of life. Each person makes these decisions based on their own priorities. However, asking, "do I *really* need this?" before purchasing something will help you establish and critique your values.

Should I substitute another product for this one?
If most products generate hazardous waste, perhaps we should buy those which last longer, so that less waste will be produced. Cotton or jute shopping bags, for example, last much longer than plastic or paper. Buying goods that are less heavily packaged and buying food in bulk quantities can reduce the amount of plastic discarded. Reusable cloth towels, cleaning rags, handkerchiefs, sponges, and cloth napkins can be substituted for disposable products.

Can I use less of this product, or use it less frequently?
Since most products involve at least some hazardous waste generation, the answer may not be in purchasing another product, but in consuming less. If the label says to use one cup of laundry detergent, will two thirds of a cup do the job?

How will I use and discard this product?
What happens to this product once it is home? Is a portion wasted? Reused? Given to neighbors? Thrown away? Once discarded, does it drift into the groundwater supply? Can it be recycled, reducing the need to process more resources?

From **Hazardous Waste and the Consumer Connection,** 1984, Science for Citizens Center, and Michigan Environmental Education Association

3. Community Crossword

ACTIVITY: Crossword puzzle to review sources of waste
MATERIALS: Handout
TIME: 10 minutes

This activity could serve as an introduction to community hazardous waste generators, as a review, or as supplement to other activities.

OBJECTIVES:

- Students will recognize that small businesses and common industries in their community contribute to the local hazardous waste stream.
- Students will begin to realize that hazardous wastes are everywhere, and that they are everyone's responsibility.

TEACHER PREPARATION:

1. Make copies of handout.

CLASS ACTIVITY:

1. Invite individual students to complete the crossword.
2. Answer questions and add to this list other potential community generators of hazardous waste.

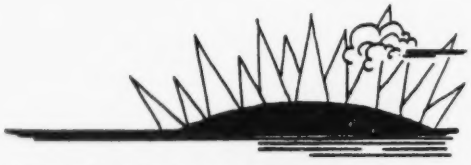
ANSWERS:

Across:

2. PHOTO
4. GAS STATION
6. AUTO
8. DRY CLEANER
10. RESTAURANT

Down:

1. HOSPITAL
3. PRINTER
5. BARN
7. JEWELRY
9. SALT



PROGRESS IN WATER QUALITY

In the good old days, nearby streams and rivers were the community sink, and just about everything went right down the drain. Garbage, industrial waste, and sewage were dumped into the water and carried away. As more people used the water as a waste processor, the rivers became more polluted. When an oil slick on the Cuyahoga River in Cleveland, Ohio ignited, the serious water pollution problems in urban areas received national attention.

Congress responded with strong clean water legislation and authorized the EPA to regulate industrial and municipal discharges. In the 1980's and 1990's the challenge will be to identify, set limits, and regulate even the smallest quantities of toxic chemicals which are discharged. This is a huge challenge, as many chemicals are invented every year!

STUDENT HANDOUT 3A

COMMUNITY HAZARDOUS WASTE GENERATORS

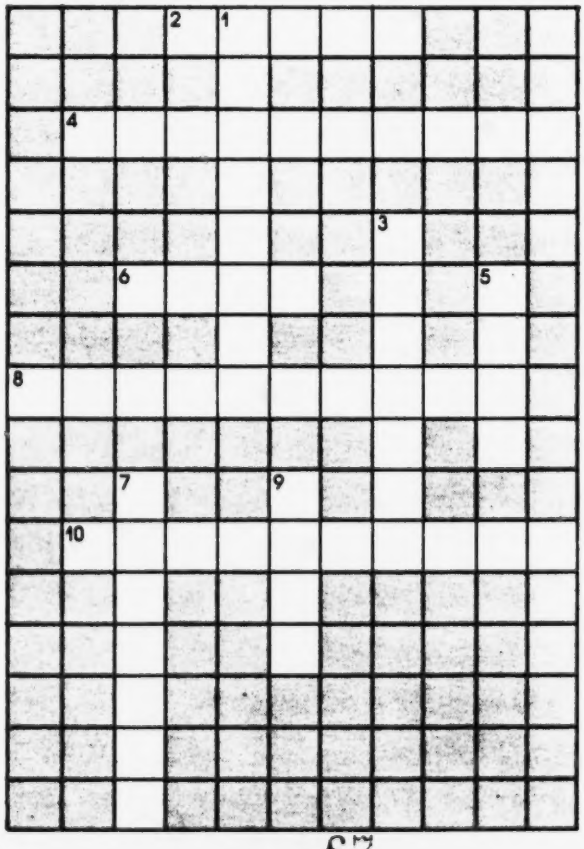
Directions: Use these clues to identify some of the common businesses and establishments in the average community that are "hidden" generators of hazardous waste. How many of these places are in *your* community?

ACROSS

2. Developer and fixer are wastes from the _____ shop.
4. Underground tanks at the neighborhood pit stop can leak and contaminate groundwater. (2 words)
6. Solvents, paints, corrosive acids, greases, and oils are commonly stored and disposed from this shop that repairs personal transports.
8. Cleaning clothes without water produces toxic waste solvents. (2 words)
10. To make sure your meal doesn't include a few insects, these establishments are sprayed periodically with potent pesticides.

DOWN

1. Infectious and radioactive wastes are commonly collected from this health-related institution.
3. "Hot off the press" can also mean "time to clean off the ink before it dries."
5. Huge quantities of fertilizers and pesticides are stored in this building, ready for next year's crop.
7. Even a _____ store has metals and soldering wastes, not just rings and watches.
9. In states where icy, snow-covered roads are a problem, these large piles can pollute groundwater when it rains.



4. Six Bits

ACTIVITY: Small group problem solving activity
MATERIALS: Six sets of six cards
TIME: 30 minutes

This activity requires that everyone in each group contribute to solving the problem — the question buried in the cards. The activity enables shy students to speak up and group members to develop leadership skills. The process is important for students to acknowledge and consider, so the discussion questions at the end of the activity emphasize this aspect of the activity. As students work on the problem, you may roam from group to group listening, observing, and encouraging.

OBJECTIVES:

- Students will practice listening with comprehension.
- Students will practice working as a group member and developing consensus.
- Students will practice communicating clearly.
- Students will appreciate the complexities of resolving issues that involve hazardous waste contamination.

TEACHER PREPARATION:

1. Copy six sets of the Six Bits Cards.

CLASS ACTIVITY:

1. Form groups of six.
2. Pass out a set of the cards to each group (one card to each person), and give the following directions:
    a. Each set contains one card with a question. The person holding this card should begin the activity by reading the question to the group. The object is to complete or work toward the solution of the problem described by the question, with the information on the other cards.
    b. You may not show your card to anyone.
    c. You may read the information on the card to anyone.
    d. Some information on the cards may be irrelevant.
3. Give the groups 15-20 minutes.

FOLLOW-UP:

Discussion Questions

1. How did leadership unfold during the activity?
2. How were decisions made?
3. How effectively did the group function? How could it improve?
4. Did you notice any difference between real and ritualistic listening?
5. What other information would be important to obtain to solve this problem?
6. For how long is an industry responsible for hazardous waste?
7. How can citizens play an active role in reaching a solution to a crisis in their community?

STUDENT HANDOUT 4A

SIX BITS CARDS

Card 1
You may not show this card to anyone in your group. You may read the information on the card to anyone.

Hooker Chemicals and Plastic Corporation dumped over 20,000 tons of chemical wastes into Love Canal, in a suburb of Niagara Falls, NY, between 1942 and 1953.

In 1978, after local health officials failed to act, the state closed the school and relocated the 239 families whose homes were closest to the dump and later purchased the nearest 550 homes, relocating 211 more families.

Card 2
You may not show this card to anyone in your group. You may read the information on the card to anyone.

In 1953, Hooker Chemicals sold the canal area to the Niagara Falls School Board for $1.00 on the condition that the company would have no future liability for injury, and the the School Board not build anything on the property.

Card 3
You may not show this card to anyone in your group. You may read the information on the card to anyone.

An elementary school and a housing project were built in the Love Canal area.

Local officials have pressed federal officials for a clean bill of health so the state can resell the homes.

Card 4
You may not show this card to anyone in your group. You may read the information on the card to anyone.

In 1977 chemicals from corroded barrels filled with hazardous wastes began leaking into basements of homes adjacent to the canal.

Occidental Petroleum made an out-of-court settlement of $25 million to residents.

Card 5
You may not show this card to anyone in your group. You may read the information on the card to anyone.

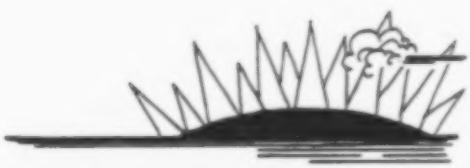
A health survey by state officials found that women between the ages of 30 and 34 in one area had a miscarriage rate four times higher than normal.

The chemical dump site has been covered with a clay cap and surrounded by a drain system that helps contain leaking chemicals.

Card 6
You may not show this card to anyone in your group. You may read the information on the card to anyone.

Occidental Petroleum faces law suits from the Federal government and New York State to recover the cost of cleaning up the area and relocating residents — who is responsible for cleaning up the Love Canal and relocating the people?

In 1978, over 1500 residents of Love Canal area sued Occidental Petroleum, which bought Hooker Chemicals, for $16 billion in health and property damages.



LOVE CANAL REVISITED

Although the tragedies of health problems, evacuations, and loss of property for the residents of Love Canal are undeniable, citizens were able to gain control over the resolution of these problems through determination and community organizing. For example, when local health officials refused to take the concerns of the citizens seriously, the citizens cleverly trapped some of them in one of the contaminated homes until the officials promised to take action to clean up the canal! This simple act helped to get the attention of President Carter who then ordered the evacuation, investigation, and clean up of the canal.

The residents' insistence on staying involved in the situation resulted in a more thorough clean up program than had occurred at other sites. The program included extensive safeguards to prevent further contamination or accidents during clean up, a technical assistant assigned to the case to explain procedures to citizens, and a one million dollar trust fund created to pay the costs of medical treatment for illnesses related to contamination in the community. The citizens focussed so much attention on the problems at Love Canal that the media and Congress began to investigate similar problems in other commuities. It is widely believed that this attention contributed greatly to the passage of the federal Superfund, the nation's comprehensive law to clean up toxic dumpsites.

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5. A Walk Through the Yellow Pages

ACTIVITY: Class project to discover local waste generators
MATERIALS: Community map, yellow pages, colored pencils
TIME: 1-2 class periods

To really understand the local issues and constraints, your students need to know what hazards are in the community. This activity will involve students mapping potential generators of hazardous waste.

OBJECTIVES:

- Students will identify potential hazardous waste generators in the community.
- Students will develop skills in mapping by plotting the hazardous waste generators on a community map.
- Students will become more aware of their own community.

TEACHER PREPARATION:

1. Make six copies of a map of your community for the students.
2. Obtain the Yellow Pages of your local phone directory and colored pencils for students to use.
3. Make or obtain a large poster-size map of your community, or a section of your community.

CLASS ACTIVITY:

1. Have the students form small groups.
2. Distribute a community map, yellow pages, and pencil to each group.
3. Discuss with the students that hazardous waste comes from a wide variety of establishments. Ask them to brainstorm or review the potential businesses and possible locations of hazardous waste in their community. This list in the Teacher Background section and the businesses included in Activity 3 may help.
4. Have each group select the type of hazardous waste generator or the section of town they would like to investigate. Using the yellow pages, invite them to find the addresses of local generators, and mark these on their map. Each generator or each group could use a different color (dry cleaners in blue, auto shops in green, etc.). When each group completes their map, ask a representative from that group to mark their data on the class map for all to see.
5. Discuss the locations and quantity of generators in the community and the implications for people, wildlife, and the environment. Where are the closest residences? Are the industries in a "poorer" part of town? Are there particular routes that would be heavily used for transporting chemicals and waste products? Do animals wander onto the property? Could adjacent plantlife be affected? Are groundwater supplies potentially affected?

FOLLOW-UP:

1. Students may want to make a telephone call or take a visit to the businesses they located to find out:
   - Which chemicals are disposed?
   - How chemicals are disposed, and where? (incineration, storage, neutralizing, etc.)
   - What are some of the problems of the way they are disposing of their waste?
   - What are some success stories they have had?
   - Are emergency plans in place to respond to accidents/leaks?
   - What volume of waste is generated?
2. See Field Trip activity 6 in this unit.

COMMUNITY GENERATORS

Auto Shops: rust removers, degreasers, paint, paint thinners, solvent, batteries, flammable cleaners, and used rags.

Construction Industry: ignitable paint wastes, used solvents, strong acids and alkalines (used in cleaning, degreasing, and plumbing).

Dry Cleaning and Laundry Plants: solvents such as perchloro-ethylene (perc or tetrachloroethylene) and valclene.

Freight Terminals: degreasers, cleaners, solvents, paints, thinners, rust removers, and batteries.

Furniture Finishers: paint and finish removers, strippers, and solvents; paint; stain; and finish.

Laboratories—Research and Development, Testing, Education, or Medical: solvents, acids/bases, toxic, and radioactive waste.

Leather Manufacturers: solvents and other liquids containing lead, dyes, or producing hydrogen sulfide.

Lumber Yard: wood preservatives, fungicides.

Metal Manufacturing—Jewerly, Automotive, Caskets, Batteries, and Machinery: solvents, strong acids and alkalines, electroplating wastes (acid or alkaline wastes containing copper, nickel, zinc, tin, or cadmium), heavy metal sludges (mercury, silver, lead, chromium), and cyanide.

Paper Industry: solvents, corrosive acids from the pulping process, ink and dye wastes, and cleansers.

Pesticide Formulators: highly toxic compounds, like arsenic, mercury, nicotine, strychnine, organophosphates (e.g. parathion) and organochlorines (e.g. aldrin, chlordane, DDT, kepone and lindane); flammable solvents.

Pesticide Users: rinsewater, empty containers, unused pesticide, and contaminated soil.

Printers: ink sludges and solvents.

Vocational Shops—Automotive, Woodworking, or Graphics: solvents such as paint removers, thinners, and cleaners; paint wastes; and strong acid or alkaline cleaning solutions.

6. Field Trip

ACTIVITY: Collecting "real" community data
MATERIALS: Handouts, industry representative or parent, transportation.
TIME: 1-2 class periods

Because of a great deal of concern about hazardous waste, many community-based industries are eager to tell their side of the story. Public relations personnel or a speakers bureau might be available to explain their hazardous waste processing system.

OBJECTIVES:

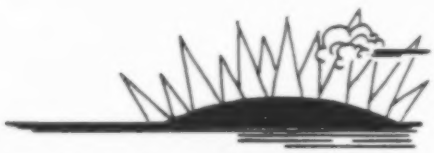
- Students will be able to identify some hazards in the workplace.
- Students will be able to recognize some safety procedures taken to prevent potential workplace hazards.
- Students will explore and utilize methods for discussing sensitive issues without infringing on others' rights to opinion.

TEACHER PREPARATION:

1. Duplicate the handout "Industrial Chemicals".
2. Arrange a field trip to a local industry, invite a representative to come to the school, or help a student representative call the PR department of the industry.
3. Refer to activities 5 and 6 in Unit 5 on dealing with controversy, if needed.

CLASS ACTIVITY:

1. Discuss with students appropriate ways to approach a representative from an industry with potentially sensitive or controversial questions. Have students role play a scenario, or watch an interviewer on TV, paying attention to the manner in which he or she asks questions.
2. Hand out the Industrial Chemicals sheet, and invite students to write down additional questions they have for their industry.
3. Take a field trip to, or listen to a presentation from an industry that generates hazardous waste in your area.
4. Afterwards, form small discussion groups to compare findings.



Trip to the Paper Plant

As the bus pulled into school ahead of the bell, Ms. Sims stood to address the students.

"To wrap up our day's field trip, let's quickly review the relevant information we gathered from the Clean Sheet Paper Company," she said.

One by one, students recalled the trip highlights:

"It's possible to make pulp without chemicals, but the paper is of lower quality."

"Sodium sulfide and other chemicals can be settled out of solution and recycled. A truly efficient plant may utilize the waste heat generated from the recycling process. Waste water can be treated with bacteria to 'clean' it."

"Recycling chemicals like chlorine means the company doesn't buy as much and doesn't discard as much. It can be an economical investment, depending on the cost of the chemical and the degree of remodeling necessary for the plant."

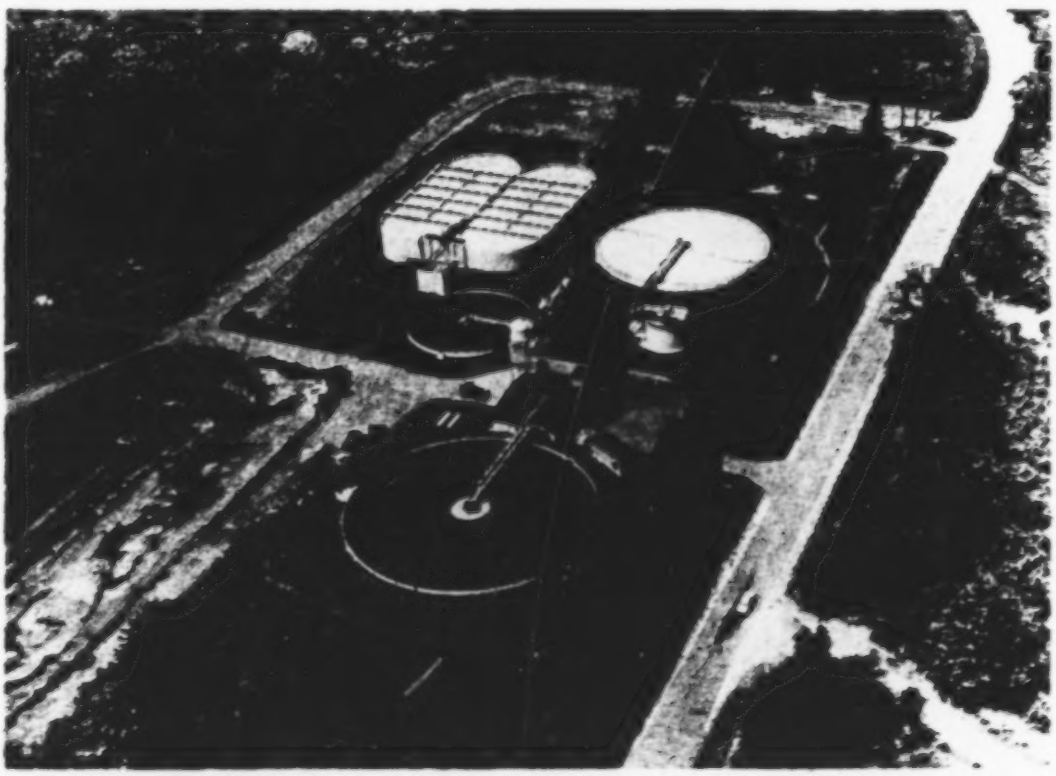
"Dioxin contamination is a growing concern with paper industry wastes."

"Hazardous wastes that leave Clean Sheet are transported 200 miles to a licensed hazardous waste landfill."

Ms. Sims continued her review by asking if the three groups had arrived at their research topic. The spokespersons stalled for time, but answered with a series of possible topics from their field trip:

The history of paper making.
Letters to other paper manufacturers asking about their recycling processes.
A map of the nearest licensed hazardous waste disposal and storage facilities.
A graph showing dollars spent and waste generated before and after the new recycling procedure was instituted.
A survey of other industries in the community.
A study of toxic chemicals associated with paper industry wastes and their possible effect on people and the environment.

Obviously pleased at their reflection and concern for the community, Ms. Sims applauded the students for their good behavior, even though she expected no less, and asked if anyone would like to write a letter of thanks to the tour guide for her knowledgeable answers and time. With one volunteer secured, the students poured off the bus and back to their lockers.



Consolidated Papers, Inc. upgraded this Water Renewal Center in 1977 with secondary treatment at a cost of $4.3 million. Their facility treats about 3 million gallons of water each day from the paper mill, removing 99% of the suspended solids before discharging it to the Wisconsin River. Annual operating expenses here exceed $1 million, a sizeable investment as the company's net income in 1986 was less than $90 million.

STUDENT HANDOUT 6A

INDUSTRIAL CHEMICALS

Name of Industry _____

Address _____

Name of Company Representative _____

What does the factory make? _____

_____

Major chemicals used to make the product _____

_____

Do the raw materials need to be transported? _____

Where are the chemicals stored? _____

_____

Are the chemicals labeled? What information is included? _____

_____

What chemicals are waste products? _____

_____

Where are the chemical wastes stored? For how long? _____

_____

How are the chemical wastes processed? _____

_____

_____

What is eventually done with chemical wastes? _____

_____

_____

_____

What steps are taken if a leak or spill occurs? _____

_____

Is the industry planning to modify the hazardous waste collection, treatment, or disposal system? _____

_____

_____

What regulations must the company comply with? _____

_____

Are safety inspections conducted? By whom? _____

_____

Are workers trained to use safety equipment and properly handle hazardous materials? _____

7. What's in a Law?

ACTIVITY: Small group discussion
MATERIALS: Handout
TIME: 30-45 minutes

This activity introduces the purpose of federal legislation regarding hazardous waste disposal by asking students to write their own legislation! A handout on RCRA follows.

OBJECTIVES:

- Students will understand more about federal hazardous waste laws.
- Students will become more familiar with the function of Congress.
- Students will explore some of the implications of RCRA.

TEACHER PREPARATION:

1. Make copies of students handout entitled "RCRA."

CLASS ACTIVITY:

1. Explain to your students that their work with hazardous wastes up to now has covered quite a few aspects of the hazardous waste issues in your area. Now they will be able to use their perspective on the problems to contemplate a solution! Most of our national problems end up in Congress, where a law is discussed, revised, and sometimes passed, that should help solve the problem and prevent further ones. In the case of hazardous waste, it is unlikely that any one law will be able to do that, so they may need to prioritize the problems and come up with the first law that will lay the framework for making an impact.
2. In small groups, challenge the class to write a framework for national legislation to curb hazardous waste problems. If they need help getting started, here are some discussion suggestions:
   - Where are the biggest hazardous waste problems — homes? schools? industries? old forgotten dumps? new disposal facilities?
   - If you could prevent hazardous waste problems, what group would you target? consumers? workers? business? industry? disposal operators?
   - Whose responsibility is hazardous waste? For how long?
   - Does anyone know how much hazardous waste there is and where it goes? Would this be important to know?
   - Who should enforce the law? Where should the money come from?
   - What types of incentives need to be in place to encourage the use of recycling or other types of permanent treatment instead of land disposal, a less expensive form of disposal?
3. When the groups are finished, ask the students to present their legislative outlines and regulations to the class. Then pass out the following summary of RCRA — the Resource Conservation and Recovery Act. This was Congress's first step toward controlling hazardous waste. Subsequent legislation (called the **CERCLA** or the Superfund Act) established a tax on the chemical industry to fund the clean up of the worst toxic dumps.
   - What ideas did the class have that Congress missed? Would all of these good ideas be feasible in this country, given private enterprise?
   - Does RCRA make sense as a first step?
   - What are the advantages and disadvantages of RCRA?
   - Should the manufacturer be responsible for landfill leaks 30 years after they thought they disposed of the chemicals properly? If not, who should be?

Federal Laws Regulating Toxics and Telephone Numbers for Further Information:

CAA Amendments 1977 - Clean Air Act - To reduce air pollution and improve air quality 800-621-8431

CPSA - Consumer Product Safety Act 1972 - To protect consumers against unsafe products 800-638-2772

CWA Amendments 1987 - Clean Water Act - To ensure that streams and lakes in the U.S. are clean from toxic pollutants 800-621-8431

Emergency Planning and Community Right to Know Act - Title III of SARA 1986 - A new national program, where citizens and government agencies can get information about toxic chemicals used by industry in their communities 800-535-0202

FIFRA - Federal Insecticide, Fungicide, and Rodenticide Act 1978- to control the use and manufacture of pesticides 703-557-7760

FFDCA - Federal Food, Drug, and Cosmetic Act 1938 (ammended several times) - To make sure products are safe and produced under sanitary conditions 202-447-5163

OSHA - Occupational Safety and Health Act 1970 - To ensure that workplace environments are safe and healthful 800-582-1708

RCRA - Resource Conservation and Recovery Act 1984 - Protection of public health and the environment by controlling the disposal of solid waste and regulating the management and handling of hazardous waste materials 800-424-9346

SARA - Superfund Amendments and Reauthorization Act of 1986 - This act is a reauthorization of the provisions of CERCLA and provides money to clean up spills and old hazardous waste dumps 800-424-9346

SDWA - Safe Drinking Water Act 1986 - For protection of the water we drink, and the wells and aquifers that supply it 800-426-4791

TSCA - Toxic Subsstances Control Act 1976 - Regulations to manage increasing problems of toxic substances and mixtures 202-554-1404

RCRA: THE RESOURCE CONSERVATION AND RECOVERY ACT

In 1976, Congress passed the Resource Conservation and Recovery Act (RCRA). This law was designed to start a national program to manage solid waste, and since hazardous waste is one kind of solid waste, one section of RCRA, Subtitle C, deals specifically with hazardous waste management. **Before RCRA was passed, there were no federal laws that dealt with hazardous waste disposal.** Now, anyone who produces, handles or disposes of hazardous waste must tell the Environmental Protection Agency (EPA) of that activity. In August of 1980, the EPA knew of 50,000 industrial waste sources, 9,700 transporters, 30,600 owners or operators of hazardous waste facilities, and 47,000 generators of hazardous waste. By sheer numbers, it is easy to see how mismanagement of hazardous waste can occur.

In 1984, Congress passed a series of amendments to RCRA, tightening restrictions on land disposal of hazardous wastes and requiring industries to take steps to minimize their wastes.

RCRA sets up federal standards which individual states enforce. The penalties are harsh for not following these standards. The EPA is responsible for monitoring the transportation, disposal, and clean-up of hazardous wastes.

The EPA:

1) identifies which wastes are hazardous and how they will be regulated
2) demands that generators of hazardous waste:
   a. keep records
   b. use appropriate containers
   c. label the containers
   d. tell the persons who handle the wastes chemicals they contain
   e. use a "manifest system"
      A **manifest** is a document which follows the hazardous waste from its generator to its final storage or disposal site. Each time the waste is given to someone else, the document must be signed and a copy filed. The operator of the last waste management center sends the signed form back to the generator, who is ultimately responsible for the safe disposal of the hazardous waste.
3) requires transporters of hazardous wastes to:
   a. record the source and destination of all wastes
   b. transport only wastes with proper labels
   c. use the manifest system
   d. take waste only to permitted disposal facilities
4) requires owners and operators of hazardous waste facilities to:
   a. follow established guidelines when: choosing and designing a site location, operating the facility, training workers, and keeping records
   b. monitor, test, and analyze the facility for chemical leaks
   c. obtain a permit to operate
   d. use the manifest system
   e. certify that they have taken steps to reduce the volume of waste they generate
5) issues permits for approved hazardous waste management facilities

The EPA can levy fines and file criminal suits if these regulations are not upheld and the hazardous waste endangers health or the environment.

8. Disposal Dilemma

ACTIVITY: Individual or group research projects.
MATERIALS: Library and handout
TIME: 2 periods and homework

Even if we reduce hazardous waste, we'll still have some and it must go somewhere. Many of the difficult questions facing communities involve the licensing of hazardous waste disposal facilities. How safe are they? For how long? Are special geological conditions necessary for them to work? This activity will give your students an opportunity to research some of these questions.

OBJECTIVES:

- Students will become aware of the possible hazardous waste disposal options.
- Students will develop research skills with one disposal option.
- Students will compare the advantages and disadvantages of different hazardous waste disposal options.

TEACHER PREPARATION:

1. Place appropriate resources on reserve in the school or public library. You may be able to upgrade the library's collection of materials by requesting current information from local organizations (see the Appendix).
2. Make copies of Handout 8A to serve as an introduction.

CLASS ACTIVITY:

1. Introduce the variety of options to your students through the handout. Are the facilities equally appropriate to accommodate them? In the past, most wastes were dumped either in a river or in the ground, and from there they traveled. All of the options listed are modern answers to the question, "How should be dispose of our hazardous wastes?" Point out that reducing the waste to be disposed will help make the job easier.
2. This small introduction does not cover all there is to know about disposal options. Invite your students to research an option of their choice, in small groups or as individuals. They should plan to present their findings to the class (so everyone can gain from their research) and answer these questions:
   - How does this option work? Is it in use now, or just a theory?
   - If it's just a theory, what needs to happen to put it into practice?
   - If it is in use, are people satisfied with it? Industry? Government? Local community?
   - Does this option rely on something — special soil, large spaces, a high quantity of wastes?
   - Is this option economically feasible? In every state? In every industry?
   - What are the advantages and disadvantages of this option?

   As the topics are assigned, make sure that the most common and most popular options (incineration, secure landfill) receive broad coverage.
3. During the presentations, have students make a list of advantages and disadvantages similar to the Teacher Background material.

PROS AND CONS OF DISPOSAL OPTIONS

Additional information is available on Student Handout 8A, "Hazardous Waste Treatment and Disposal Methods," and in the Glossary.

	PROS	CONS
LANDFILL:	Are presently available Not too expensive Improved regulations	Problems with leaching Uses precious land Not secure for the future Availability is decreasing
INCINERATION:	Reduces volume of waste Detoxifies chemicals Reduce envir. effects Energy recovery possible Byproduct recovery	Very expensive High maintenance costs Possible air pollution Communities usually unhappy Possibility of accidents
SALT DOMES:	Self-healing Won't hurt salt supply No migration Strong Economically effective	Uses domes not beds Earthquakes can fracture Not available everywhere
OCEAN DUMP:	Economically feasible Huge capacity	Potential damage to marine ecosystems through leakage Saltwater is corrosive to most containers
DEEPWELL INJECTION:	Cost effective Good for neutralized liquid wastes	Only for liquids Earthquakes or normal geological movement can cause fractures Must be geologically secure within non-porous layers Must locate below potable water Groundwater contamination highly possible
MICROBIAL DEGRADATION:	Totally destroys waste Decreases liability Cost effective Minimal disturbance to site No harmful endproducts	Only certain chemicals are eligible Must keep proper conditions (pH, temp., humidity) Large scale may be problem

STUDENT HANDOUT 8A

HAZARDOUS WASTE TREATMENT AND DISPOSAL METHODS

WASTE REDUCTION—Cutting down the amount of hazardous materials in the waste stream.

Individuals can play a role in reducing hazardous waste by purchasing items that generate less waste, purchasing items in less packaging, reusing items more often, and recycling items.

Industries can reduce their quantity of hazardous wastes by making changes in the production process, reducing packaging, and exchanging waste chemicals with an industry that can use them. In changing the production process, manufacturers could use less hazardous chemicals, switch to safer materials, separate hazardous from nonhazardous wastes, and reduce production mistakes.

Waste Exchanges have been established in some areas to act as a clearinghouse for toxic, but reusable materials. One industry rids itself of a waste product, and another industry is able to purchase it at a reduced cost as a raw material for its process.

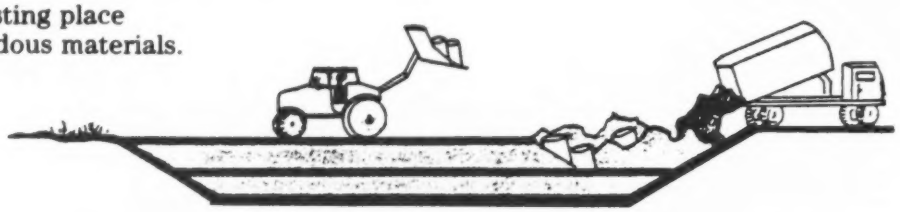
TREATMENT—Reduces the volume and concentration of hazardous materials and makes it easier to manage.

Chemical Treatment such as neutralization, precipitation, oxidation, reduction, ion exchange, and fixation help reduce the toxicity of certain chemicals. For example, acids and bases can be chemically treated; if properly done, the waste product is water and a salt.

Physical treatment decreases the volume of wastes by solidifying the chemicals and evaporating or treating the liquid. Treatment may include: filtering materials through a screen, sand, or carbon, allowing gravity to separate particles, evaporating water, or cementing wastes together. Very little leaching occurs when solidified wastes are buried in a landfill.

Incineration burns wastes at very high temperatures. During this procedure toxic organic compounds can be broken down to safe gases, the volume of waste is reduced, and the heat is generated that can be used to make electricity. However, the fuels and equipment for this process are expensive, and leftover ash must still be disposed. Incinerator walls become corroded. Due to their composition, not all hazardous wastes will burn.

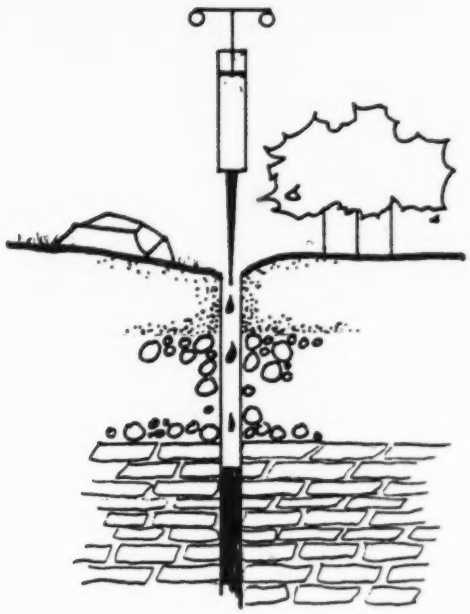
DISPOSAL—The final resting place of the hazardous materials.



Ocean Dumping was used in 1978 to dispose of dye production wastes, acidic iron wastes, and some pharmaceutical wastes. Some wastes were put on old cargo ships and sunk, others were put in containers, and some were simply poured in the water, severely damaging marine ecosystems.

Deepwell Injection forces industrial wastes under the groundwater level, past layers of harder rock, and into an absorbant layer of sandstone and limestone. The harder non-porous rock separates the groundwater from the hazardous material layer. This is an inexpensive way to dispose of wastes. Some people wonder if these wastes may become mixed with drinking water or cause earthquake tremors. There are at least 180,000 shallow injection wells holding hazardous wastes that were injected into or above rock layers near ground drinking water sources. Federal regulations require shallow wells be discontinued in the future.

Microbial Degradation, or biological treatment can eliminate hazardous compounds by transforming them into nontoxic forms. Bacteria feed on many kinds of organic chemicals in soil and degrade them into harmless substances. The soil must be at a warm temperature, have a good oxygen supply, nutrients,and a favorable pH to maintain a healthy environment for the organisms. Oil spills are often treated with hungry bacteria.



UNDERGROUND STORAGE/DISPOSAL

Salt mines seem relatively ideal for the long-term, controlled storage of hazardous wastes because of their stability in movement, temperature, water, and humidity. Hazardous wastes are pumped into salt domes or mine tunnels are stacked with barrels, then sealed.

Basins and Lagoons are shallow, surface holding ponds for liquid hazardous wastes. They are not designed as permanent containers, but as temporary mixing areas or evaporation ponds. They can leak, crack, overflow, corrode, or catch fire.

Secure Landfills. Old landfills were merely a hole in the ground where barrels of hazardous waste were covered with clay to keep out rainwater. Now there are proposed EPA regulations for "secure" landfills, although no landfill, no matter how well engineered, will be secure forever.

1) Landfills must be constructed in dry areas away from water supplies.
2) They should have a plastic or clay lining.
3) The pit area should be surrounded by a drain and pump system to catch and remove any leaking wastes.
4) Wastes that react with each other must be kept in separate areas.
5) Ignitive, reactive, and volatile wastes should not be included.
6) Liquid wastes should be solidified.
7) Drums and tanks should be surrounded by absorbent materials in case the containers explode, rupture, or corrode.
8) Gases should be collected, monitored, and controlled.

9. Can We Work It Out?

ACTIVITY: Group simulation and problem solving.
MATERIALS: Handout
TIME: One period.

This activity simulates a community searching for a solution to a hazardous waste problem. By representing some of the various viewpoints involved, students will gain an understanding of the complexities of these issues.

OBJECTIVES:

- Students will improve group discussion and decision-making skills.
- Students will gain an appreciation for complex community interactions.

TEACHER PREPARATION:

1. Duplicate the scenario, Handout 7A.
2. Prepare an easy way to divide the class into two sets of groups, perhaps by cards with two marks (see below).

CLASS ACTIVITY:

1. Introduce this as a two part problem solving exercise. In the first part, students will meet in 5 groups. Each group will discuss and decide on a position statement. In the second part, one member from each group will meet 4 other people, all from different groups, and discuss the problem. They will try to reach agreement.
2. Distribute the scenario of the community problem, and ask students to form five equal groups: Local Community Government, Local Citizens, U.S. Environmental Protection, State Government, and Scientists. Instruct each group to determine their position — their viewpoint, and the extent to which they can tolerate giving in on that position. In other words, what can they afford to compromise in order to reach agreement?
3. After 10 minutes, ask one person from each group to form a community, a second person from each group to form another community, and so on until every student is in a community that consists of a representative of each of the original groups. The community group's task is to try to reach agreement on the problem at hand.
4. Give the groups 10-15 minutes to discuss their viewpoints and bargain on a solution, then ask one person from each group to disclose their end result.
   - How different are the communities' solutions?
   - What makes them different?
   - How did the decision get made? Did everyone have an equal voice?
   - In real community decision making, does everyone have a voice?
   - In communities where one group is an obvious "loser," how did that happen? How does that person feel?

SCENARIO

In a small rural village in Ohio, citizens began complainig about health problems and strange odors near their homes. Their concern prompted the state officials to investigate a nearby abandoned lot. There they found about 1200 drums containing PCB's, oils, solvents, and resins, four dilapidated wooden buildings, four concrete silos, and one railroad tanker were discovered on 13 acres. The closest homes to this hazardous dump are only 75 feet away. No one knows which industries left the wastes on the site — and they will probably never know.

After five years of citizen effort, a six foot fence was built around one area and the drums and two inches of soil were removed. High levels of heavy metals, solvents and other suspected carcinogens were still detectable in the soil and groundwater. The biggest problem was the four silos, where the soil contamination ran to four feet deep. In this area, the groundwater table is only four feet deep.

The Ohio Environmental Protection Agency is responsible for determinifg the plan of action for final clean up of the site. Tomorrow a public meeting will be held in which the EPA will listen to all the viewpoints about how to plan the clean up. The following groups have these perspectives:

U.S. EPA
Your agency will have to provide the funds for the majority of the clean-up operation. There are many similar sites throughout the country. Also any contaminated soil from this site will have to go to another site.

State Government
You must allocate funds from the U.S. EPA to clean up all of the sites in this state. You believe that U.S. EPA often chooses incomplete rather than comprehensive clean-up measures in the interest of saving money.

City Council Member
You live in the community and are elected to represent its citizens. Demanding more than is realistic could make you look ineffective.

Citizens
You fear for your health and your children's health. Anything less than complete clean-up of this threat is not good enough.

Scientist
It is very difficult to prove that an exposure to toxic chemicals has caused a health problem. However, you know that the only way to make sure that these chemicals do not continue to threaten the health of the community is to remove all threat of exposure.

Clean-up Steps — the plan of action for final clean-up of the site could include one or a combination of all these clean-up steps:

fence off the whole area
cap the area to contain contaminants in the soil
excavate the entire area and take soil to another site
incinerate the contaminants at the site
install a groundwater purifying system
use a chemical neutralizing technique (e.g. microbial degradation)

10. To Build or Not to Build

ACTIVITY: Moral dilemma
MATERIALS: Handout
TIME: 30 minutes

Despite our good efforts to resolve problems, there are still tough questions to answer. In this activity, an incinerator that is likely to contribute to local deaths due to cancer is under question. Should it be built? How many people should die?

OBJECTIVES:

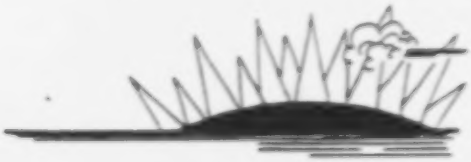
- Students will practice communication skills.
- Students will wrestle with an ethical decision.
- Students will listen to other students' decisions.

TEACHER PREPARATION:

1. Make copies of handout 10A, "World's Largest Trash-Burning Plant".

CLASS ACTIVITY:

1. Ask the students to form groups of 4 or 5.
2. Give each student the handout, asking them to read it and resolve the stated question. Remind the students to be good listeners and to express their feelings clearly.
3. After all groups have worked on the questions, ask each group to explain their decision and the reasons for their judgement.



KOMMUNICHEM

In Denmark, industries do not have a choice in how they dispose of their hazardous waste. It must go to one of Kommunichem's disposal facilities. Kommunichem is a semipublically owned hazardous waste disposal industry. Local governments and industry work with the national government to sponsor Kommunichem, which monopolizes the hazardous waste industry.

Kommunichem uses its own fleet of rail tankers to bring hazardous waste to its disposal facilities. Because it's the only industry that disposes of hazardous waste, the high volume pays for the high costs.

Only a small percentage of waste is treated and put in landfills. The rest is incinerated or detoxified. These methods are very expensive and encourage industries to decrease their wastes and recycle as much as they can.

Denmark's method of hazardous waste disposal contrasts greatly with the United States. U.S. industries try to get rid of their hazardous wastes as inexpensively as the law allows. Our many disposal companies usually take waste to landfills or deep well injection facilities because these are cheaper than recycling or incineration. Because it costs so little to get rid of wastes, not all U.S. companies reduce the amount of wastes they produce before sending it to a landfill.

STUDENT HANDOUT 10A

WORLD'S LARGEST TRASH-BURNING PLANT

(A Moral Dilemma)

Question: Should the state Department of Natural Resources (DNR) revoke the previously granted permit to build the world's largest incinerator for municipal solid waste?

The DNR Air Quality Control Division has given a large metropolitan city a permit to build the world's largest trash-burning plant without state of the art pollution control equipment, despite warnings that the plant would increase health risks.

The Director of the DNR has explained that financing for the $470 million project would be lost if the DNR required modern pollution control equipment at an additional cost of $17 million to $30 million. The Governor and the Director of the DNR both feel the plant should be built without requiring state of the art pollution control equipment.

The plant would burn 4,000 tons of municipal solid waste every day (including household hazardous wastes) and produce steam to generate electricity.

The DNR's decision to recommend building the plant without state of the art pollution controls will make it easier to get the money to build the incinerator.

When the DNR gave the City a permit to build the plant it was believed that the added risk of operating the plant would result in only one additional cancer death for each one million residents (that meets the state criterion).

A subsequent investigation showed that the plant might result in 38 additional cancer deaths per million for people who spend a lifetime where the heaviest concentration of chemicals would fall.

To reduce the health risk the city would need to install a combination of scrubbers and a pollutant collection bag house to remove toxic chemicals from smoke-stack emissions. The toxic chemicals include dioxins, hydrochloric acid mist and sulfur dioxide. Some of the chemicals are carcinogenic, and others are corrosive and can damage property or cause respiratory problems.

If the plant were not built, the trash containing household hazardous wastes, would continue to be sent to the city's sanitary landfill. Most scientists and policy-makers believe incinerating solid waste is much preferred over landfills, because land is not plentiful near urban areas and homes cannot be built over old landfills.

Unit Review

Before leaving this unit, ask your students to brainstorm a list of the community issues they see with hazardous wastes. What organizations and efforts exist to overcome these problems? What sorts of things could the class do to help contribute to resolving these problems?

This list will be useful in Unit 5 when your class begins such a project.

Unit 5

Community Action Project

Throughout this curriculum, you've read examples of positive steps that lead to answers for our hazardous waste problems. Even though the magnitude and the implications of toxic wastes are huge, the situation is not hopeless. Concern and action can bring important changes and resolutions on this critical issue. Every community has the resources to solve their problems and make wise decisions — if government, industry, and citizens are committed to finding an answer, and if citizens have the awareness, knowledge, commitment, and skills to create the needed changes.

This unit provides a framework to guide you through a community action project. Your class's participation in such a project will achieve two goals: 1) your community will reap the benefit of your efforts, and 2) your students will gain problem solving skills, knowledge of the issues and of appropriate action strategies, and a sense that their efforts can bring about change. The purpose of this unit, and indeed, the purpose of this curriculum are embodied in these two goals. The framework provided in this unit will give you and your students an outline and a guide to begin your community action project. Every community and every project will be different, so you may not need to follow all these steps in the order given. This is a generic set of guidelines, to be modified by your best judgment and your class's interest.

Activities are built into the following framework of Action Steps:

STEP	Page
1. Review Action Strategies	5-3
Activity ***1. Three Case Studies***	5-4
Handout 1A: Case Studies	5-5
2. Identify a Problem and Clearly State It	5-8
Sample Problems and Projects	5-9
Activity ***2. Reaching a Decision***	5-10
3. Collect, Organize, and Analyze Information	5-11
Activity ***3. Collecting Data***	5-12
4. Generate Several Solutions and Select One for Your Project	5-13
Activity ***4. Project Pros and Cons***	5-14
Handout 4A: Pro and Con Analysis	5-15
Sample Pro and Con Analysis	5-16
5. Be aware of different Opinions and Values	5-17
Activity ***5. How Do Others Feel?***	5-18
Activity ***6. Community Sensitivity***	5-19
Handout 6A: Guidelines for Learners working in a Community	5-20
6. Form an Action Plan	5-21
7. Implement the Project	5-22
8. Review Your Project	5-22

If this list of steps looks too long for your class, there are many variations that will still provide your class with a well developed experience in problem solving. You may have a project in mind (cutting the problem identification step), you may work with another organization on their action project (eliminating the need for your class to identify the best solution), or you could run through the entire experience as a role play or simulation.

Different Ways to Select a Community Action Project

1. **From another chapter.** At the end of each of the previous chapters, your class did an activity to brainstorm associated issues in your community that they might address. Any one of these issues may have sparked your class to take action and to lend their efforts to help solve this problem. You may use this chapter to guide you and your class through the development of a project that was born from a previous unit.
2. **From a community concern.** Your community may have its own significant hazardous waste problem that prompted your interest in this curriculum and that concerns all of your students. You might have started this curriculum in this chapter because of your intent to center your study of hazardous materials around this particular issue. You may use this chapter as a guide to your project, and use the previous chapters to present information as you need it. For example, if your class wants to address a problem with groundwater contamination from an old dumpsite, you will breeze through the Problem Identification step, but during Data Collection, your class may start off with the information and activities on groundwater in Unit 2 or the Appendix.

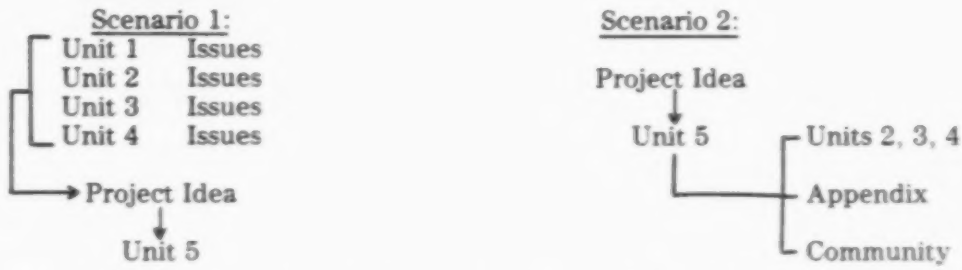


Figure 5.1: Developing a Community Action Project from this Curriculum.

Any way you get here, the following unit is a set of guidelines and suggestions to launch your class into a community action project. Activities found elsewhere in this curriculum will be particularly useful for this section, both for group process (see Skill Building section in the Appendix) and for content (e.g., septic systems, home hazards, RCRA, etc.).

STEP 1. REVIEW ACTION STRATEGIES

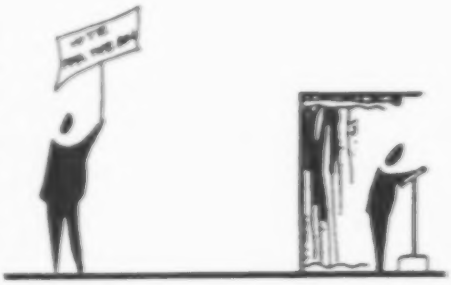
Before actually getting started on the problem solving process, your students may appreciate a broad background in the possible strategies and actions they could take. The following activity will review three real problems and citizens' attempts to solve them. This case study approach will give your students some vicarious experience with which to begin their own problem. For your reference, and to complement the case studies, an explanation of four categories of action strategies appears below.

ACTION STRATEGIES

1. **Persuasion** Persuasion is used when someone or a group of people try to convince others that a certain course of action is correct. This could be a logical presentation of facts, an experiential approach to building awareness, or an emotional appeal. Letters to the Editor, posters, advertisements, and modeling certain behaviors are ways to provide information, raise awareness, and ultimately, persuade people.

2. **Consumerism** Consumerism is the power of the dollar. It involves buying or not buying a product according to your philosophy. It is usually only effective when a group of people buy or boycott a product together. Consumerism also involves teaching consumers to conserve something, or to buy less of it. Often, a very appropriate project involves informing people of the connection between their purchases and the issue, or the consequences of their actions, and providing a concrete way for them to begin to make a difference: changing their purchasing habits.

3. **Political Action** Political action is anything that brings pressure on political groups or government agencies to persuade them to take a certain action. It usually means voting or supporting a certain candidate or referendum that favors Right-To-Know Legislation (labelling chemicals in the workplace and/or community) or better hazardous waste disposal technology, writing letters about your experience or feelings regarding hazardous wastes, distributing petitions, or lobbying.



4. **Ecomanagement** Ecomanagement describes any physical action that improves the environment — distributing flyers about a household hazardous waste collection drive, working at the collection drive, running chemical tests on a local river and monitoring it for changes that may indicate a problem with toxic chemicals, or not disposing hazardous waste in the sewage system.

1. Three Case Studies

ACTIVITY: Homework reading assignment and small group discussions.
MATERIALS: Duplicated study sheets
TIME: Overnight assignment and one class period the next day.

Doing something to save the world, or even benefit your own community certainly sounds good, but without concrete images of what other people have done, it's hard. These case studies illustrate what regular people tried to do to improve their local hazardous waste problem. One example is from Scotland to help students realize the inherent advantages in a representative democracy.

OBJECTIVES:

- Students will understand a variety of methods that students and citizens can use to solve environmental problems.
- Students will develop an appreciation for the long hours of work that environmental issues require to resolve, and the smaller tasks that can be completed in a reasonable time frame.
- Students will appreciate the system in the USA that allows citizens to participate in the environmental problem solving process.
- Students will work within a small group to generate and discuss possible strategies they can use to affect change on a local issue.
- Students will develop decision-making and leadership skills.
- Students will develop life-long learning skills.

TEACHER PREPARATION:

1. Duplicate the following five student handout pages.

CLASS ACTIVITY:

1. Distribute copies of the three case studies, (Student Handout 1A). You may prefer to assign the readings as homework.
2. On the next day, or when everyone has read the case studies, divide the class into small groups of 4-6 students to discuss questions at the end of the handout.
3. After a 20 minute discussion, bring the group back together for a synthesis of the issues. Make a master list of their action ideas and constraints.
4. If needed, complete their list with the information on Action Strategies detailed on the preceding page. Spend some time describing the strategies that will be most successful with your students.

STUDENT HANDOUT 1A

CHEMICAL PLANT BRINGS JOBS AND TROUBLE TO MONTAGUE, MICHIGAN

When the periodic fumes from the chemical plant down the road got so bad that they filled Mrs. Dawson's home with an acrid smell, she finally decided to take action. "That's it," she said. "We're going to do something. What they are doing is wrong, and I feel so threatened by it that fighting it is more important than anything else."

After knocking on the doors of 25 families living within 2 miles of Hooker Chemical and Plastics Corporation and finding similar sentiments, she presented her findings to the Department of Natural Resources and the Air Pollution Control Commission at a citizens meeting. Nineteen of the households reported breathing difficulties and strong fumes.

Although the DNR was aware that Hooker was disposing toxic chemical waste into the nearby lake, the pollution team had only gently encouraged Hooker to manage its wastes better. Mrs. Dawson's meeting helped the state officials realize that stronger enforcement measures were necessary. The meeting also alerted the media to the problem and they began to cover the issue more thoroughly.

Mrs. Dawson's meeting and a signed statement from an employee revealing some of the chemical problems in the plant set in motion a chain of events that is still continuing 9 years later. After water, soil, and air tests, reports, more tests, meetings, hearings, lawyers, and out-of-court settlements, Hooker finally admitted they were responsible for contaminating the air, the soil, and the groundwater near their plant. They promised to clean it up.

Today, part of Hooker's chemical plant and a million cubic yards of contaminated soil are buried inside a sealed, concrete vault. The pyramid-shaped structure is so big that the bottom covers an area that could contain 14 football fields. Part of the chemical plant still operates, and so does a giant groundwater collection and filtration system. It pumps water out of the ground and through a filter 24 hours a day. This will continue until a court decides the aquifer is clean. Hooker is spending $16 million to repair their mistake.

Would the state agencies have acted on their own to clean up the problem without Mrs. Dawson? Probably, but it could have taken much longer. The people who work for these agencies do not live near the problem site, they do not have the same use of information the neighbors have, and they are often busy and overworked. In many cases, state agencies are happy to work with informed, concerned citizens. With broad local support and good media coverage, the agencies are much more effective.

The DNR enforcement chief, Jack Bails, credits the citizens who live in Montague with helping in the Hooker case. "Without the citizen complaints, the Hooker issue might have lingered a very long time and the consequences would have been much more severe.... When citizens tell us we're not doing our job well enough and the facts support them, we'll take action."

from **Audubon** (87:15) pp. 104-115

FARMERS LOOK FOR ANSWERS

Tugging his reddish beard in frustration, the Scottish dairy farmer pointed to the sickest cows in his herd. One had just given birth to a blind calf, bringing the herd total to 6 blind calves in one year — something was most definitely wrong. She had been among the herd that grazed near the hazardous waste incinerator in Bonnybridge. Now, nearly three years later, Mr. Graham was still calling scientific laboratories and tracking down leads, trying to help his cows.

In 1980, Mr. Graham split his herd, sending half to graze in the shadow of a hazardous waste disposal incinerator. When his cows became sick and their milk yield decreased, Mr. Graham had the milk tested for the standard pollutants. The Scottish Milk Board found nothing out of the ordinary, and asked Mr. Graham to keep his concerns to himself; a rumor about chemical contaminated milk would upset many people.

The incinerator belonged to Re-Chem, the largest British firm in the business of burning hazardous waste. They operated three plants at the time, one each in Scotland, England, and Wales. The Scottish plant burned PCBs (Polychlorinated biphenyls), a very toxic and long-lasting hazardous waste that requires a very high temperature to completely destroy. If the burn temperature is too low, the PCBs may be converted into more toxic chemicals. Although there were plenty of local complaints about the toxic emissions, Re-Chem continued operations without changes.

In the United Kingdom, the government strongly supports industry. Although Mr. Graham sent his milk and samples for tests, he was afraid the government-based labs would hide any damaging evidence against Re-Chem. The labs were not an independent source of information.

An American toxicologist working in West Germany offered to help. He surveyed the herd and discovered "a walking disaster area." When the results of his soil samples and animal tissue tests came back, Mr. Graham learned his soil and his cows had low levels of PCB and other chemicals. Evidently the incinerator did not completely destroy the waste chemicals. Still, the Milk Board refused to take action and milk from Mr. Graham's cows was sold to people all over Scotland.

Mr. Graham did not have enough evidence or money to fight or win a court case to close Re-Chem, nor could he afford to slaughter his cows. Furthermore, Mr. Graham knew that within a 30 mile radius of the Re-Chem plant every dairy herd was in the same situation. Many of those farm families who drink only their own milk were quite ill with strange diseases. Several women gave birth to babies with unusual eye deformities. Their cows stumbled around the barnyard, barely able to walk. Many of the farmers met the same frustrating responses from veterinarians and scientists — no one could help.

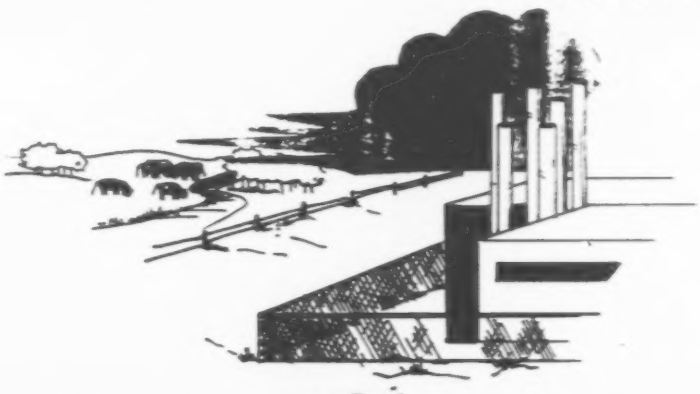
The newspapers could not inform people of the problem, either. In England and Scotland there are strong laws about publishing stories without all of the facts documented. The newspapers could not write about the case of Mr. Graham's cows because no legal action had proven his story.

Finally, in 1984, the workers at the Bonnybridge plant in Scotland refused to burn PCBs, and the plant closed for "financial reasons." Without a law suit that established Re-Chem's guilt, however, Mr. Graham could not collect any money to replace his ruined dairy herd.

Several U.S. scientists inspected the remaining plant in Wales and commented that it was a very sloppy and unsafe operation. Tests indicated the incinerator did not burn the chemicals adequately. These scientists were amazed at the mildness of public protest.

"In the U.S. there would be riots at Re-Chem's gates," said Edward Kleppinger, an environmental consultant from Washington, D.C. Another scientist thought that such a disaster occured because of the lack of public interest groups, no congressional investigation, outdated libel laws, and the peoples' trust in government. At the time of this writing, the Wales plant was still in operation — the government investigations have failed to prove a link between the incinerator and the human and animal health problems.

From **Audubon** (87:6) pp. 134-143



STUDENT VIDEO SHEDS LIGHT ON TOXIC DUMP CONTROVERSY

For a town of its size, Stoughton, Wisconsin has more than its share of toxic waste. The old city dump and two abandoned landfills just outside town were found to be leaching toxic volatile organic chemicals into the groundwater. The chemicals are known to cause health problems if consumed in sufficient quantities over a long enough period of time. As one would expect, the local residents quickly became concerned about their health, their children, and their future.

The old city dump was legally closed before anyone was aware of the contamination, and a city park was created on top of it. Some people are more anxious to see the softball diamonds used and enjoyed than the dump excavated. As the Wisconsin Department of Natural Resources tried to get the sites included on the U.S.E.P.A.'s Superfund hazardous waste clean-up list, the Mayor of Stoughton fought to preserve the softball fields. In addition to involving scientific discrepancies and disagreeing values, this problem also involved politics and poor communication.

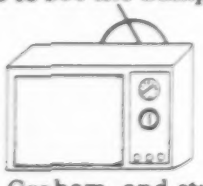
High school students in Dr. Steven Landfried's Contemporary Political Affairs course became interested in the controversy as a part of their research assignment. After carefully planning a strategy to investigate the situation from all possible angles, they proceded to arrange and conduct interviews with representatives of the city, Department of Natural Resources, representatives of the media, worried dumpsite neighbors, their U.S. Congressman, and even the Governor of the state. Dr. Landfried recorded most of the interviews on video tape with equipment borrowed from the Stoughton cable television station. They wanted to document the issue, and help the community understand the controversy.

Before long the students had amassed a tremendous amount of information: eight hours of video tape of interviews and on-site visits, hundreds of pages of written information, slides from the DNR of the original dumpsites, many brochures and pamphlets, and a song written by a local environmental troubador: "Stoughton Toxic Blues". And when several local television stations learned about the kids' attempt to create a high-tech term paper, they offered to let them use clips from some of the many stories which had appeared during the previous two years.

Four months after the project had begun, the students began to assemble their video documentary. Working very hard to assure that each side was provided with plenty of opportunity to explain their positions, their 42 minute documentary was finally ready for its public premier.

Considerable attention was given to assuring that the premier received wide-spread publicity. With the cooperation of the editor of the local paper, the entire community was invited to join the 34 people interviewed for the program for the first showing. Nearly 60 people attended and many people participated in the forum lead by Dr. Landfried immediately after the premier. To the students' delight, everyone was very happy with the result, because each side had been fairly represented. Interestingly, the new mayor of Stoughton announced that for the first time ever representatives from the DNR had met with city officials the day before. As a result, the students and their parents left feeling like they had had a role in bridging a divisive gap between state and local government.

Despite the city's refusal to avail themselves of outside help, the students took great satisfaction in the public education success of their project. Though the saga is not over yet, within 18 months two other of the toxic dumpsites studied had been added to the EPA list and another was under consideration.... and the city was still trying to get their park off the list. Commented one student interviewed: "We would just like to see the dump cleaned up and more studies done to find ways to do that safely."



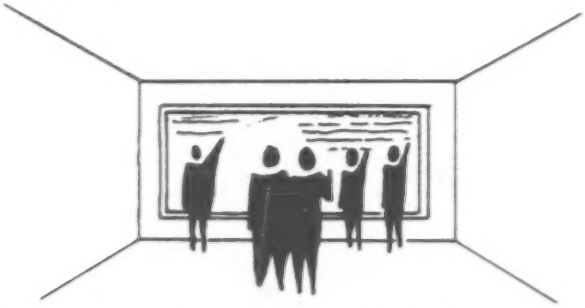
Discussion Questions

1. Make a list of ways Mrs. Dawson, Mr. Graham, and students took action to solve their problem.
2. Make a list of the problems they had taking successful action.
3. What are some of the reasons that Mrs. Dawson got results, finally, from her action?
4. What are some of the cultural differences between the countries and the people in the case studies? Do you think you might find differences between groups of people in your community that could affect your project?
5. Do you think these community activists did the right thing, or did they just cause trouble? What do you think other people in their communities thought?
6. What are preliminary steps that can be taken toward successful community action that do not make people mad?
7. Starting with your list from the first question, continue with ideas of all the ways you could take action in your community.

STEP 2. IDENTIFY A PROBLEM AND CLEARLY STATE IT

In this step your class will 1) identify the problems they would like to explore, based on their understandings of hazardous waste issues in homes, their school, and the community, 2) identify criteria with which to determine a "good" hazardous waste problem, 3) choose one problem, and 4) state the problem clearly.

A. Identifying Possible Problems



If your class used the first, second, third, or fourth units of this curriculum, they generated a list of problems in the home, school, and community. You can begin a discussion of potential hazardous waste problems by starting with these lists. Ask your students to continue to generate problems they would like to help resolve. Each problem is likely to have many solutions. Each are potential projects that the class can tackle. At this stage, it is only necssary to choose a specific problem for the class to research, but not a class project. Make sure that there is a genuine interest in the problem, not a desire to work on a particular project when the students suggest ideas. They may discover, after their research, that this first project would not be a good idea. See insert on Sample Problems and Projects for some ideas.

B. Identify Criteria for Choosing a Problem

To make a decision on which problem to explore, the class will need to identify what makes a "good" problem. Here are few ideas to get them started:

1. Problems should be relevant and of high interest to everyone in the class.
2. The problem should have adequate information available about it, so everyone can research the problem.
3. It might be useful to pick a problem that other people or organizations are working on. Support and leadership are important. The local Environmental Protection Office or a Public Interest Group, or other civic organization may be an appropriate spot to look for a project.

Continue to generate criteria, and then return to the list of problems.

C. Choosing A Problem

Ask small groups of students to work together, evaluating each problem on the list against the criteria they have suggested until some have been eliminated, or some look very promising. Help the class choose one problem to address. If the class has trouble agreeing on a problem, try the activity ***Reaching A Decision*** in this unit.

Some Sample Problems and Projects

1. **Home Problem:** Oil- and water-based paints are common household hazardous wastes if they are dumped improperly before the can is empty.

   Project: Students coordinate efforts to notify residents of their concern, encouraging them to use up the paint before the cans are trashed.
   Project: Students organize a collection of household paints for donation to several agencies that can use them.
   Project: Students work with a health department or other agency/organization to announce a community household hazardous substance collection day.

2. **School Problem:** An outdated school policy is lacking several measures that would protect students and teachers from hazardous materials.

   Project: Students research the proper policies, write a draft version, and present their suggestions to the School Board, developing a lobbying strategy to build support.
   Project: Students create and post a series of safety posters to tell other students of appropriate precautions around hazardous materials.
   Project: Students write and produce a play on school-based hazardous substances and safety.

3. **Community Problem:** Citizens are angry and frightened about a recently discovered hazardous waste dump that is leaking toxic chemicals.

   Project: Students write letters to the Editor of the local newspaper about the issue and an upcoming public hearing. They also research and distribute flyers to hand out to people who attend the hearing.
   Project: Students host a forum, giving local leaders and EPA officials an opportunity to explain the problem, and citizens a chance to ask questions.

D. Stating the Problem Clearly

Take a few minutes after a problem has been identified and approved by your class to clearly state the problem, exactly and concisely. Your attention to detail at this stage could save some heartache later on. A clearly defined problem will help students identify the information that needs to be collected, the solutions that are appropriate, and the best project for them to address. Check on the usefulness of your problem statement by giving the statement to someone unfamiliar with your concerns. Did that person understand the problem?

2. Reaching a Decision

ACTIVITY: Large Group Discussion
MATERIALS: Blackboard, chalk
TIME: 10-20 minutes

If your group is having difficulty reaching a decision, there are several sources of assistance for you. First, look over the activity on Transactive Discussions in the Skill Building Section of the appendix. It will help students see perspectives from others' viewpoints. You may find the following activity to be a useful framework for decision making.

OBJECTIVES:

- Students will begin to appreciate and respect different opinions in the class.
- Students will work through a process that allows for a decision to be made without denying anyone an opportunity to express themselves.

CLASS ACTIVITY:

1. Write all ideas that are being considered (problems, projects, directions, actions, etc.) on a large paper or blackboard. Beside each, write any advantages and disadvantages that have been identified.
2. Ask if anyone has good reason to object to one. If yes, the originator of that idea should, after hearing the reasons for the objection, decide whether to withdraw it or not.
3. Review the criteria with which this decision should be made. Ask the group what qualities of the choices should be considered.
4. Continue to ask for objections (or strong disadvantages) until you have eliminated several of the items.
5. Assume that five choices remain. Let each person make an individual assessment according to the criteria that the group has agreed to. For example, if you are choosing a project topic, you may consider the time line, urgency, ability to make a difference, and personal preference. Ask each member to rank order the choices with 1 = worst choice and 5 = preferred choice.
6. Add together all the scores for each project. The one with the greatest number of points should be the one that pleases everyone.
7. Confirm the group's choice by commenting on the many advantages of this project. Make sure it is really a strong candidate, and not a result of poor arithmetic.

Contributed by Klaus Berkmuller, FAO India

STEP 3. COLLECT, ORGANIZE, AND ANALYZE INFORMATION

With your problem statement in mind, the class needs to collect more information about the problem, its history, and the possible actions the students might take. Of course, the students should generate a list of questions to be answered and think about sources for this information. Depending upon the problem, your students may need an introduction to local government before they make progress. The following handouts may help them gather data on a school-based or a community-based issue. Feel free to modify the questions to meet the needs of your group better.

Here are some additional suggestions for resources for the class to consider:

- Magazines
- Community Newspapers
- League of Women Voters
- Environmental organizations
- Concerned citizens
- Public affairs representatives or scientific experts of industries and agencies
- City, county, or state agencies
- Elected officials
- Teachers
- Neighbors
- Other students
- Professional people in the community
- Books
- Activities in Chapters 1, 2, 3, and 4 of this curriculum
- Appendix of this curriculum

As information is gathered by your students, encourage them to report their findings to other class members. Assign the tasks of compiling the information to a few students — they should begin to reorganize the data so that it can be easily understood and analyzed. Skills in communications and graph-making may come in handy! Your time may be needed to support, advise, and caution students when necessary.

3. Collecting Data

ACTIVITY: Small Group Research
MATERIALS: Phone book, Local Resources
TIME: 1-2 class periods

Students will need to understand the decision making process and to collect information about their school or community to be able to help make small changes. This activity presents five ideas for assembling the knowledge they will need.

OBJECTIVES:

- Students will improve their understanding of the power structure that governs the changes they are requesting.
- Students will gain an appreciation for local politics.
- Students will improve their communications and group process skills.

TEACHER PREPARATION:

1. You may need to gather information about the political process that governs the arena in which the students have chosen to work. You may even line up a guest speaker to present information about setting policy, if the students will need to know that material.

CLASS ACTIVITY:

1. In the context of the problem your students have selected, explain the process by which decisions are typically made. What organization holds the power to change the situation (School administration, School Board, City Council, County government, etc.)? From this background, divide the class into five groups to work on each of the following areas. Feel free to alter them to match your situation.

   A. Which committees (formal committees and advisory committees) might work on issues related to your project? What are the names of the people on these committees? Are they elected representatives (swayed by public opinion) or appointed? Have they investigated this problem before? Have they recommended any solutions?

   B. Which organizations might be interested in your project-especially those that work well with the people who will ultimately make the decision? These groups may be able to lend their problem solving expertise, their time, their money, or their credibility to your project. Coalitions of groups are often more effective than a single group. The League of Women Voters, public interest organizations, the PTA, the teachers' union, a local nature center, retired citizens, the Health Department, and a local business are potential ideas for support. Also think about the people and organizations who might be affected by this problem. How might they be able to help you?

   C. What is the history of this problem? Have other groups tried to solve it? What were the results of any previous actions? What seem to be the obvious causes of the current situation, and what may be some hidden causes of the problem?

   D. What role do the following organizations play in hazardous waste issues in your community? Can any of these people or organizations help your class with the project?

   a. fire department
   b. police department
   c. health department
   d. Department of Natural Resources
   e. Environmental Protection Agency
   f. Ecology Center/Nature Center
   g. U.S. Coast Guard
   h. transportation department
   i. hospital staff
   j. landfill operators
   k. wastewater treatment plant operators
   l. local university or college
   m. public interest groups

   E. If your class wants to formally request a change in the policy, what is the appropriate procedure that you should follow? Do you send a letter? To whom? Do you appear in person? When? Do you go before a committee? When do they meet, and should they have a written statement before you get there? There should be an ombudsman (in the schools) or a clerk (in government) who can help answer these questions.

STEP 4. GENERATE SEVERAL SOLUTIONS AND SELECT ONE FOR YOUR PROJECT

By the time your class is well into their information collection phase, they might have good ideas about possible solutions to their problem. This step is only to make sure that the first idea is not the only solution considered, and to reflect on the definition of the problem once again. As projects develop, it is often easy to lose sight of the goal. Are you still on target? Should the problem statement be modified?

Most problems have more than one answer. Among the many answers, some have more serious consequences than others. It's important for your group to be certain their action will help solve the problem they identified and not create more problems as a result.

As in Step 2, first the class should generate a list of possible solutions to the problem, that is, projects for the class. Secondly, help them identify the criteria that should be used to choose an appropriate project. Here are some suggestions:

- Good projects are tangible and practical.
- Projects should be of high interest and relevant to everyone in the class.
- The project should be action-oriented, and involve everyone.
- The project should have adequate information available.
- The proposed project should be challenging, yet not overtax skills and abilities of the group; something that your students can actually change.
- Consider how much time you have to work on a project — if it is important that the students complete the project, make sure it fits well within your timeline.
- The project should not polarize your community, putting students in the middle. It should raise awareness or help resolve a problem.

As the class uses the criteria to bring up a few project ideas, divide the class into smaller groups, and give each group one project idea. Then ask them to work through the following activity with that project in mind. It will help students evaluate the situation and list the forces that are at work to maintain status quo or to promote change. Recognizing these forces will help students work around and with them.

After the activity, ask the class to analyze their solutions again — does one make more sense than another? Return to the criteria — are they making a wise choice? If the group needs assistance choosing among several good projects, try the activity ***Reaching A Decision*** in this unit.

4. Project Pros and Cons

ACTIVITY: Small group discussion.
MATERIALS: Handout sheets
TIME: One class period

When the class has generated several possible solutions (i.e. projects) for the issue they would like to tackle, this activity will help analyze the positive and restraining factors for each, and help the group make a wise decision about the expenditure of their resources.

OBJECTIVES:

- Students will analyze the forces working for and against a proposed change.
- Students will practice listening with comprehension and express oneself clearly.
- Students will work as a group member, and as a group leader.
- Students will provide feedback to each other.
- Students will work toward group consensus.
- Students will contribute to group problem solving.

TEACHER PREPARATION:

1. Copy for each member of the class the Pro and Con Analysis page. You may choose to duplicate the Sample Completed Sheet, too, depending upon your students.

CLASS ACTIVITY:

1. Divide the class into small groups so that each proposed solution will be addressed by at least one group.
2. Pass out the Pro and Con Analysis Handout, and walk the students through it as they discuss answers.
3. Have groups state the problem and the goal (their proposed solution) at the top of the page.
4. Ask the groups to identify the *driving forces*, or the aspects in the situation that push toward positive change and will help support the project. They should identify these positive, supportive forces for themselves, for others, and for the situation. They may need to do some outside research.
5. Next, have the groups identify the cons, the *restraining forces*, the forces within themselves, others, and the situation, that will block their efforts to implement their project. Becoming aware of these forces will help students decide if they should work on this project at all, and if they decide to go on, how to organize their plan of action.
6. Then, ask the groups to determine a series of possible actions that they might take to help achieve the goal.
7. Finally, have each group identify the resources that are needed to meet their goal — both that are available and that they still need.

Additional Idea: Students may want to continue this process and design a flow chart of the project, what should be done to achieve the goal, when, where, who, etc. This is nearly an action plan, Step 6 in the sequence.

FOLLOW-UP:

A discussion about the *process* of completing this activity could help your students understand the group process skills they are developing, and help them work together more effectively. Below are some ideas for a discussion:

1. What are the possible advantages of using a strategy of this type in solving everyday problems? What disadvantages? Has this been a helpful strategy to each group in working to identify best solutions to the problem?
2. What type of leadership qualities were evident in the group leaders? Did this prompt more participation? Why or why not?
3. Did everyone have a sense of security while in the group? Why or why not?
4. Was everyone able to communicate their thoughts clearly?
5. Was there any disagreement among group members when they were generating the lists of the forces? How were the disagreements resolved?
6. Did any problems arise which hindered the problem solving process?

STUDENT HANDOUT 4A

PRO AND CON ANALYSIS

THE PROBLEM:

THE GOAL:

PRO FORCES/DRIVING FORCES	CON FORCES/RESTRAINING FORCES
SELF	
OTHERS	
SITUATION	

POSSIBLE ACTIONS:

RESOURCES WE HAVE:

RESOURCES WE NEED:

PRO AND CON ANALYSIS — SAMPLE COMPLETED SHEET

THE PROBLEM:

There is no place to dispose of hazardous household wastes such as paint, fertilizers, car oil, etc.

THE GOAL:

The Junior High students will sponsor a collection day for household hazardous wastes at a central location

PRO FORCES/DRIVING FORCES	CON FORCES/RESTRAINING FORCES
SELF	
Strong interest to do something about safely disposing of hazardous wastes	A feeling that there is no support from the community environmental groups
OTHERS	
Community leaders and civic groups are supportive and want to help youth set up the drive	Some people in the community don't recognize that household hazardous wastes are a problem
SITUATION	
Many junior high students have volunteered to educate citizens about the collection day	There is a lack of financial aid to educate the community about household hazardous wastes

POSSIBLE ACTIONS:

Students distribute educational materials in certain neighborhoods about household hazardous wastes, the need for proper disposal, and the date for the collection.

RESOURCES WE HAVE:

Materials

RESOURCES WE NEED:

Adults
Money

STEP 5. BE AWARE OF DIFFERENT OPINIONS AND VALUES

The ability to think broadly from a variety of viewpoints is a skill that your group may find will smooth out wrinkles in their project, and help things go better. Guide a discussion to cover the different interests or motivations of the people involved in the problem and project, including your students! The attitudes of all the actors greatly influences the ability to find an easy resolution. For example, your group can address questions as:

- Who might welcome the project?
- Who might oppose the project?
- Why would the opposition feel this way?
- Who might not listen to our statements? Why not?
- How can we approach these people to introduce the project better?
- Are these people stuck in a difficult situation which leaves them no good choice?
- How will the people involved react to the information we give them?
- How can we better understand the views of the people who might oppose the project?

The following two activities may help your students understand different values, and clarify their own. The first activity, ***How Do Others Feel***, is an introduction to thinking about the feelings and values of other people. It may be easier to start here, thinking about family members, than to predict the feelings of community leaders.

The second activity, ***Community Sensitivity***, helps students discuss the effects of working with other people in a controversial area. Great care and patience may be needed to make sure this experience is a positive one.

5. How Do Others Feel?

ACTIVITY: Large group discussion
MATERIALS: None
TIME: 45 minutes

Brief role plays of situations that could cause people to be offended, hurt, or angry will help your students practice the fine art of "thinking before talking."

OBJECTIVES:

- Students will become aware of the feelings of others.
- Students will become aware of the situations which may lead to someone becoming offended.
- Students will practice speaking tactfully to avoid offending people who have different opinions.

TEACHER PREPARATION:

To prepare your students for this discussion, you could start by discussing the following scenarios — how do students feel when they don't do the right thing? Is it any different if it is an accident, or if they really think it is the right choice? Does the magnitude of the problem change the feelings you might have? What is the best way to tell someone that you think they could improve their actions?

CLASS ACTIVITY:

1. Use the following questions in a small group discussion format to generate discussion.
   - Someone gives you a birthday present that you don't like. How do you thank them for it; what do you say?
   - You give someone a birthday present they obviously do not care for. How do you feel? What should they say to make you feel better?
   - You try to help your Mom by cooking dinner, but it doesn't taste very good, and the kitchen is a mess. How do you think she feels, and how do you feel? To make the best out of your good intentions, what should you both say to each other?
   - Your older brother is certain that he is doing the right thing. You are sure he is making a mistake. He has invested a lot of time and money in his decision. How can you help him see your point of view? How will he feel? What can you say to help him listen?
   - Your parents are busy, responsible adults. They purchase the household cleaners that clean the best, for the least amount of money. You would like them to change their favorite cleaners for ones that are not as toxic. What do you say? How might they react, positively or negatively? How can you encourage them to change without upsetting them?

FOLLOW-UP:

You could also invite several guest speakers who represent opposite viewpoints to discuss an issue with your classroom. Encourage these speakers to present the facts and their feelings, and inform them that a representative from the opposition will also present information.

6. Community Sensitivity

ACTIVITY: Small group discussion and role play.
MATERIALS: Handout
TIME: One class period.

OBJECTIVES:

- Students will listen with comprehension.
- Students will practice expressing themselves clearly.
- Students will identify values and feelings that should be respected.
- Students will begin to reduce prejudices, like sexism, ageism, racism, if any.
- Students will work as a group member.

TEACHER PREPARATION:

1. Read over the Teacher Background section.
2. Duplicate the handout: Guidelines for Learners Working in a Community.

CLASS ACTIVITY:

1. Group the students into threes to discuss each of the topics on the handout.
2. Then have each group create and act out a skit based on a topic of their choice. What are the negative outcomes if the advice in the handout is ignored? How could these problems be overcome? Different groups of students could decide on different environments for the issues — a community where no one cares about the problem, and a community where everyone is highly concerned, for example.

TEACHER BACKGROUND

1. Be familiar with the student handout, "Guidelines for Learners Working in a Community".
2. In handling controversial issues, the teacher should:
   - be aware of and take into account the policies of their parent institution/organization.
   - assist the learners to identify problems, collect information, identify alternative solutions, develop a plan of action, and work toward a resolution.
   - know if the make-up of the group is appropriate for the issue.
   - emphasize the issue from an ecological, economic, political, social, and technological point of view.
   - strive to bring in divergent views, references, and resource people.
   - emphasize all aspects of a problem before making decisions.
   - emphasize the fact that a learner may or may not agree with another's point of view but should respect that person's right to hold that belief.
3. Before progressing into the action phase, the group should consider the social implications of any action.

STUDENT HANDOUT 6A

GUIDELINES FOR LEARNERS WORKING IN A COMMUNITY

Self and resource evalution

1. Be aware of your personal values and prejudices — elitism, classism, racism, ageism, sexism, (etc.).
2. Be aware of personal values that might be different from the values of the people in the part of the community where your project will be.
3. Be aware of the interactions among people.
4. Be aware of the resources that you and each of the other members bring to the team.

Sensitivity toward the Community

1. Do not enter the community like "gangbusters," remember that you are not the only people in the area who are interested in this project.
2. Be a good listener.
3. Do not try to get rid of community leaders — you need their cooperation. Involve the key community members in the project by asking them to help shape the project's action plan. Ask for and use their ideas for solutions.
4. Be informed about the community — the people, the government, politics, functioning of the community, concerns of the residents, etc.
5. Be aware of and work with community people and organizations that have the resources and past experience to assist you in your study — League of Women Voters, County Health Department, etc.

Implementation of Action

1. Give credit where credit is due; practice humility.
2. Be aware of the social implications of your project.
3. Develop strong ties with the community, individuals, and organizations in order to build support for this project in the long term.

STEP 6. FORM AN ACTION PLAN

A. Establish Objectives: Each project needs some sort of road map — some way of knowing what to do next, when you should start the next step, and when you are finished! Much of your action plan is probably in your head, and it is important that all of your students have the same plan and timeline in their minds. With your students, review the problem and their solution. What are the objectives; what do you all hope to accomplish from this action?

B. What steps should be taken? Knowing your objectives should make it easier to identify the action steps that should be taken, and in what order. For each suggested action step, critique the idea by asking if it is feasible, if it meets your objectives, if it is likely to succeed, and if the entire class agrees to it.

C. The Action Plan: To create an action plan, have the class organize their ideas into a manageable time frame, and assign different students with the responsibility of completing each step. For a longer project, you may want different action plans to cover each phase. Students can review their progress at the end of each phase, assess the needed changes, redefine their direction, choose new responsibilities, and move on to the next phase.

Action plans are tools for you and the students to make the task or project a bit easier. They are not sacred documents, and as you proceed they should change, bend, grow, and accommodate your changing perspective. When you establish the plan in the beginning, try not to give the impression that it is a rigid schedule.

Example of an Action Plan

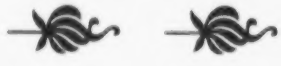
Group	A	B	C	D	E
Talk to League of Women Voters	x				
Talk to County Health Dept.		x			
Establish Advisory Committee					x
Talk to printer				x	
Ask the Student Council for funds			x		
Report back	x	x	x	x	x
Start writing flyer	x	x			
Start designing a flyer			x	x	
Review flyer text and design					x
Rewrite flyer	x	x	x	x	x
Print flyer			x	x	
Write news releases	x	x	x	x	x
Distribute flyers	x	x	x	x	x

STEP 7. IMPLEMENT YOUR PROJECT

With the action plan in hand, some projects nearly take care of themselves. If so, help the students communicate their findings, make sure everyone has a responsibility, and keep the momentum moving. If the project gets off track or screeches to a halt, return to the action plan to make changes, consult other organizations working on the problem for new ideas, or alter the scope of the project. Small successes are much more important than large, half-finished attempts.

You may find the following ideas useful for supervising a successful project:

- Contact the individuals in your community who could obstruct or support your project, and try to win them over.
- Utilize the expertise of people who have organized similar projects before. You can't be too prepared.
- Tape record important meetings or presentations so students can go back to them for additional information.
- Keep a log of events and consequences of the project. Ask a student or two to share the responsibility of generating a written record of the project or scrapbook. Try to make a visual record of the project, too, with a videotape or slide film.
- Before it is all over, ask some students to prepare a summary of the project for a video or slide presentation. They will be proud of their efforts, and the documentation will be an excellent way to introduce a project of this scope to future classes.



STEP 8. REVIEW YOUR PROJECT

The audio-visual summary of the project is a great way to capture the physical events your project entailed, but don't ignore the other dimensions of potential growth in your students. Encourage them to reflect on the progress of their project, the contribution to the community, the benefits of their emphasis on the problem, and how they feel about their involvement. Would they have done anything differently? What did each of them gain from the experience? What other projects would they like to tackle in the future?

Appendix A.

Group Process Activities and Community Sensitivity Guidelines

TO THE TEACHER:

Within the framework of this hazardous waste program, it is important for students to have good group process skills. This program encourages students to work together and culminates in a problem-solving activity, which requires a high level of familiarity with intra/interpersonal communication skills, transactive discussion skills, and community sensitivity skills.

These activities provide fundamental skill building in these crucial areas of development. A stable foundation of skills must be developed from the outset so as to provide the appropriate link to all future activities contained within this program. The activities can be used in any unit at any time.

GOALS — To increase student ability to:

a. **listen** with comprehension, including the reasoning of another individual.
b. **express** oneself clearly, including the reasoning behind one's decision on an issue.
c. **identify resources** of the group.
d. **reduce "isms"** (racism, sexism, ageism, classism).
e. work as a **group member**.
f. be a **group leader**.
g. **provide feedback**.
h. work toward **group consensus**.
i. **implement change**.
j. contribute to **group problem solving**.
k. be **sensitive** toward the community and the handling of controversial issues.

The overall group preparation phase has been divided into three distinct areas of preparatory development.

Section One:	Group Process Skills (intra/interpersonal development)
Section Two:	Transactive Discussion Skill Training (active listening)
Section Three:	Community Sensitivity Skills (teacher guidelines for students entering a community to study and or take positions on hazardous waste issues).

The development of group process techniques is the major goal of this preparatory activity section. A series of planned activities are provided with accompanying guidelines for their implementation by the teacher. The activities should be selected to facilitate growth in particular skill areas. Depending upon initial evaluations made by you with regard to the group's "skill level", it will be necessary to utilize all or part of the six activities that follow in this unit. The accompanying chart highlights the various skill areas to be developed, and the associated activities which involve these skills.

In addition to providing a stable foundation of skills, this preparatory section is meant to introduce students to the potential for developing greater awareness of and responsibility for attitudes and behaviors which they hold. In order for students to internalize the learning provided through the program, it is essential for them to take an *active role* in seeking out these new and often challenging aspects of our environmental and moral crises.

For an open atmosphere of exchange to exist, a certain level of trust must be built within the group. Many of the activities deal with extremely sensitive issues which require a considerable degree of personal introspection. The learning environment must be free from adverse criticism and divisive behavior. Students must become acclimatized to this new process of open sharing, honest interactions, and lack of ridicule by peers. The development of this type of atmosphere should make the class more cohesive and should, therefore, lay the groundwork for successful programs through the year. This usually doesn't happen overnight, and will depend on how well the students know each other, how the environment is structured, and your teaching style. The following activities will provide a variety of experiences in which this "group process" may flourish.

The activities that follow can be used in one of the following ways: 1) involve all students in all of the group process skill building activities; or 2) select particular group process skill activities for all students to experience, and other activities when the class situation dictates the need to build particular group skills (this may mean the use of selected activities for some groups within a class that are experiencing particular group process skill difficulties). Furthermore, the teacher may desire to initiate the use of this curriculum by using one or more group process building activities, or by interspersing the activities throughout the program as deemed desirable.

SECTION ONE: GROUP PROCESS SKILL DEVELOPMENT

Figure 1. Skill Development Chart

Group Process Activities:	A	B	C	D	E	F	G	H	I	J
1. ***Listening Triad*** (in this section)	X	X		X			X			
2. ***Common Squares*** (in this section)			X	X	X					X
3. ***Transactive Discussions*** (in section 2.)	X	X		X	X		X			
4. ***Six Bits*** (see Unit 4)	X	X			X	X		X		X
5. ***To Build or Not To?*** (see Unit 4)	X	X								
6. ***Project Pros & Cons*** (see Unit 5)	X	X			X	X	X	X	X	X
7. ***Reaching A Decision*** (see Unit 5)				X	X			X		X
8. ***Community Sensitivity*** (see Unit 5)	X	X	X	X	X			X	X	
9. ***How Do Others Feel?*** (see Unit 5)	X	X		X			X			

Group Process Skills:

A. The ability to **listen** with comprehension.
B. The ability to **express** oneself clearly.
C. The ability to **identify resources** of the group.
D. The ability to **reduce "isms"** (racism, ageism, sexism)
E. The ability to work as a **group member**.
F. The ability to be a **group leader**.
G. The ability to **provide feedback**.
H. The ability to work toward **group consensus**.
I. The ability to **implement change**.
J. The ability to contribute to **group problem solving**.

1. Listening Triad

ACTIVITY: Small Groups and discussion activity
MATERIALS: Seven sets of five cards
TIME: 40 minutes

OBJECTIVES:

- Students will learn to listen with comprehension.
- Students will learn to express themselves clearly.
- Students will become aware of racism and sexism.
- Students will learn to provide feedback.

TEACHER PREPARATION:

1. Xerox seven sets of the five cards in the student handout section.

CLASS ACTIVITY:

1. Have the students form groups of triads.

(speaker) (A) ---------- (B) (listener)

(C) (observer)

2. Each triad is given 2 topic cards.
3. Participant A speaks for 2 minutes from one of the cards (or any other topic of their choice).
4. Participant B listens and after 2 minutes — summarizes, without notes, what he or she has heard.
5. Participant C is observer. Participant C and the speaker listen to the summary and if incorrect they are free to interrupt and clear up any misunderstanding.
6. Shift roles for second round — 2 minutes, with the speaker choosing a different card.
7. Shift roles for a third round — 2 minutes.

FOLLOW-UP:

Some potential questions that might be explored by the teacher:

1. Did "good" listening occur (accurate, correct interpretation, etc.)?
2. Any signs of "isms" (sexism, elitism, classism, racism, etc.) within the triad or in the speakers's words?
3. Did people express themselves clearly?
4. How was feedback received?

STUDENT HANDOUT 1A

LISTENING TRIAD CARDS

Card #1

It is the responsibility of industry to maximize profits only after providing environmental safeguards that prevent social costs (such as pollution or groundwater contamination) from being passed on to the surrounding community.

Card #2

Hazardous wastes have created "the environmental problem of the century", second only to nuclear war.

Card #3

To reduce illegal dumping, large hazardous waste producers must use a "cradle-to-grave" manifest system — that is, they must keep track of hazardous wastes from point of origin to point of disposal.

Card #4

The United States should require all firms producing small amounts of hazardous wastes and all firms recycling and reusing hazardous wastes to be regulated by the Environmental Protection Agency (EPA).

Card #5

The United States should ban the practice of burying dangerous hazardous wastes in landfills and encourage recycling, reuse, treatment, and new disposal methods.

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2. Common Squares

ACTIVITY: Small groups and process activity
MATERIALS: Seven folders containing five medium-size envelopes, each with different size pieces to form five common squares.
TIME: 30 - 40 minutes

OBJECTIVES:

- Students will learn to identify resources of the group.
- Students will become aware of racism and sexism.
- Students will learn to work as group members.
- Students will contribute to group problem solving.

TEACHER PREPARATION:

1. Cut out one set of the five common squares found in the teacher background section of this activity and label each of the pieces accordingly. Then label five medium-sized envelopes with one of the five letters (A,B,C,D,E) on each of the five envelopes. Then place all pieces with the letters A into the A envelope. Repeat the same process for pieces with the other letters. Then place the five medium-sized envelopes into a large envelope.
2. Repeat procedure #1 six or seven times to accommodate a class of 30 or 35 students.

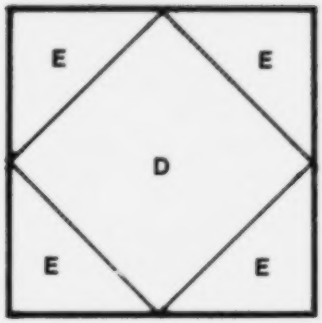
CLASS ACTIVITY:

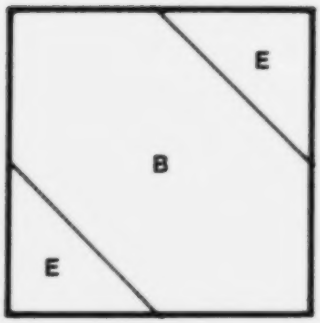
1. Ask students to form groups of five by placing their desks together or sitting on the floor.
2. Provide the groups with the information set forth below.
   A. Provide each group with five envelopes each with different size pieces to form the pattern of the common squares (A,B,C,D,E) noted in the teacher background section. Within each of the envelopes will be pieces that other group members need to complete five squares — all of the same size and utilizing all of the pieces.
   B. Inform each group that the task is completed when each member of the group has a square in front of him/her identical in size to that of the other members of his or her group.
   C. Instruct group members that throughout the entire activity there will be no verbal communication between them.
   D. Teammates may give away any of their pieces to help another person. However, they are not allowed to take pieces from another teammate.
   E. After a group has successfully completed the task, have them observe (without talking) other groups that are still working.

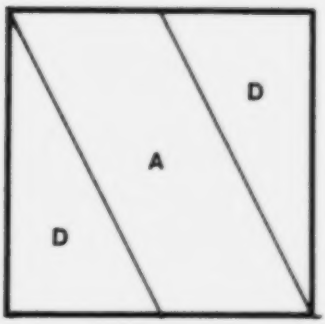
FOLLOW-UP: (immediately following the completion of the activity of all groups).

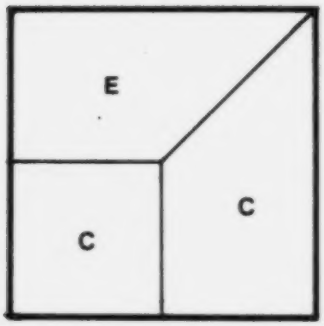
1. What type of leadership qualities were evident in your group leader?
2. Did most people participate in solving problems? Did you?
3. Did you accept help from other group members?
4. Did you have a sense of security during the activity?
5. Did you sense any signs of sexism in your group during the activity?
6. Was there any sign of "isms" from group members?
7. Was there group cooperation?
8. Was there a total group effort to solve the groups' problems?
9. Did your group work as a unit?
10. Were you aware of not only your own resources (pieces of information — construction paper), but resources of others?
11. At what point did you feel satisfied? (when your small group completed their square, or when all members of the class completed their squares?)

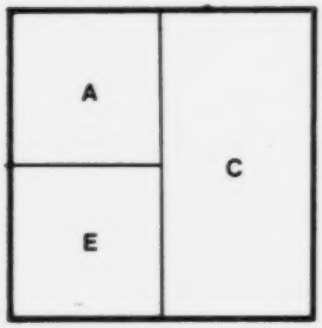
COMPLETED SQUARES











SECTION TWO: TRANSACTIVE DISCUSSION TRAINING

In general, our educational institutions tend to overemphasize the content and neglect the process of presenting curriculum materials to students. The substance of what we wish to teach may be clear to us, but often times the most effective method to present it is not. The success of this program depends both on its integration into the learning process within the regular curriculum and the manner in which it is approached. The teaching of controversial issues, such as hazardous waste, requires careful guidance or facilitation on the part of the teacher and open dialogue among the learners. One method that has proven successful is called transactive discussion.

Transactive discussion is an educational method that emphasizes the student's ability to communicate the reasoning behind his/her decision on an issue and to comprehend the reasoning of another individual. The technique involves discussions in a dyad (two people) or in a larger group and concerns students' positions taken on a given dilemma. This type of discussion becomes transaction when it is reciprocal and bidirectional in nature. In contrast, an interactive discussion is simply a conversation between individuals who do not reach a mutual level of understanding.

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3. Transactive Discussions

ACTIVITY: Small groups and discussion
MATERIALS: Handouts
Time: 30 minutes

OBJECTIVES:

- Students will learn to listen with comprehension.
- Students will learn to express themselves clearly.
- Students will become aware of sexism and racism.
- Students will learn to work as group members.
- Students will learn how to provide feedback.

TEACHER PREPARATION:

1. Copy Student Handout 3A.

CLASS ACTIVITY:

1. Discuss with the class a **non-transactive dialogue** and a transactive dialogue and the significance of each.
2. Give the **non-transactive discussion** to a male and a female member of the class and ask them to read part A and part B. Then ask the class whether the dialogue was a non-transactive or transactive discussion, and why.
3. Give the *transactive discussion* to another male and a female member of the class and ask them to read part C and part D. Then ask the class whether the dialogue was a non-transactive or a transactive discussion, and why.
4. Have the students form groups of triads. Speaker A and B then select a hazardous waste situation to discuss and try to engage in a *transactive* discussion. The observer listens to the short discussion and comments why he/she thinks the discussion was a non-transactive or transactive discussion.

Speaker A ---------- Speaker B

C Observer

5. The triads then shift position and continue the process one more time.

FOLLOW-UP:

1. Hold a class discussion on the significance of Transactive discussions and Non-Transactive discussions in helping to resolve hazardous waste issues.

TRANSACTIVE DISCUSSIONS

Researchers have found that interpersonal understanding and moral development results from the transaction in which each member engages the reasoning of his/her discussion partners with his/her own reasoning. An example of a non-transactive dialogue on hazardous waste:

A. I think it's too bad people can't use the river for swimming sports.
B. Yeah, it's really dirty and sometimes I've seen it have an oily surface in certain parts.
A. I think the people that pollute it with unsafe wastes should be fined.
B. Well, if the city paid to clean it up, everyone could use the river to swim, windsurf, and fish.

The discussants, A and B, merely take turns presenting their own personal beliefs on the subject. They are not operating on one and the same levels of moral reasoning, nor do they demonstrate comprehension of each other's reasoning. Now, an example of a **transactive dialogue on hazardous waste**:

C. Does your family change the oil in their cars themselves? We don't because we don't know what to do with the oil.
D. Yes, we do, and we recycle the oil. Our neighbor pours the oil in the storm sewers though, and it bothers me.
C. What concerns you?
D. The storm sewers feed into the nearby river, so in effect they are pouring oil — a hazardous waste — directly into the river. So, I guess my *concern* is that my neighbor may be killing aquatic organisms.
C. But isn't the oil diluted so much by the time it reaches the river that it doesn't matter?
D. You're right, if my neighbor were the only person that added oil to the river, but there are others. And oil's not the only contaminant. So I believe we all need to reduce every possible addition of waste to our waters.
C. So your neighbor contributes to the large problem in a way that's very simple to correct.
D. Right, like recycling used oil.

In the above example an authentic exchange is occurring. Individuals C and D attempt to analyze their thoughts and reasoning on the issue by questioning and clarifying the focus of their discussion.

In implementing this process of transactive discussion, both the facilitator, i.e., leader, and the learner should be aware of the choice, justification, and position that participants take on the hazardous waste issue. Also, it should be emphasized that a warm, open supportive environment is essential to encourage the discussants to freely offer their positions and reasoning on a potentially sensitive issue. The teacher's role is to direct and maintain the conversation gently on the reasoning level and to insure that students are attempting to understand their partner's reasoning process.

Research has shown that when a person actively questions another's reasoning in moral dialogue, individual moral growth occurs. This is due to the development of "cognitive conflict" or disequilibrium in the thought processes of the participants as they attempt to integrate incompatible reasoning into their personal belief systems. On the other hand, when antagonistic dialogue occurs, the learner sidesteps, or ignores the other person's reasoning altogether and growth is hindered. When conflict or cognitive dissonance occurs during a transaction, the learner may either accept the other's reasoning and assimilate it into his/her belief system, or realize that it does not conform to his/her own reasoning processes. If the learner decides an alternative perspective makes more sense, she/he may engage in a process of restructuring his/her ideas and advance to a higher level of interpersonal or moral reasoning (Berkowitz, Kohlberg).

Transactive discussion is an effective tool for education concerning controversial issues because it helps promote clear communication processes. Transactive communication skills can aid in an individual's acceptance and understanding of the different perspectives and values existing in the world. A society characterized by reciprocal communication and understanding is a society that moves closer to resolving its differences and socio-environmental problems.

STUDENT HANDOUT 3A

A. I think it's too bad people can't use the river for swimming sports.

B. Yeah, it's really dirty and sometimes I've seen it have an oily surface in certain parts.

A. I think the people that pollute it with unsafe wastes should be fined.

B. Well, if the city paid to clean it up, everyone could use the river to swim, windsurf, and fish.

C. Does your family change the oil in their cars themselves? We don't because we don't know what to do with the oil.

D. Yes, we do, and we recycle the oil. Our neighbor pours the oil in the storm sewers though, and it bothers me.

C. What concerns you?

D. The storm sewers feed into the nearby river, so in effect they are pouring oil — a hazardous waste — directly into the river. So, I guess my *concern* is that my neighbor may be killing aquatic organisms.

C. But isn't the oil diluted so much by the time it reaches the river that it doesn't matter?

D. You're right, if my neighbor were the only person that added oil to the river, but there are others. And oil's not the only contaminant. So I believe we all need to reduce every possible addition of waste to our waters.

C. So your neighbor contributes to the large problem in a way that's very simple to correct.

D. Right, like recycling used oil.

SECTION THREE: TEACHER GUIDELINES FOR STUDENTS ENTERING A COMMUNITY TO STUDY AND/OR TAKE POSITIONS ON HAZARDOUS WASTE ISSUES

Some of the projects your students will work on will take them out of your classroom and into the community in which you live. Other projects may take them to the school board — your immediate "community." In either case, your students need to be deeply aware of their personal values, the values of the group they are a part of and the values of the community sector in which they will be involved.

The activities outlined in the previous two sections will complement and set the stage for this the third section in the area of intrapersonal and interpersonal valuing and communication. Through transactive discussions, values may be clarified within learners about the hazardous waste issue confronting the community.

The purpose of this section is to assist students in becoming more effective in studying and taking positions on hazardous waste issues that relate to the community in which the students reside, or the larger state-national-international community.

This phase of this activity is to group the learners into triads and to discuss each of the topical areas under the "Guidelines for Learners Entering a Community to Study and Take Positions on Hazardous Waste Issues." This handout is found in the ***Community Sensitivity*** activity in Unit 5. Another relevant activity is ***How Do Others Feel?*** also found in Unit 5.

Appendix B.

Resources for Students and Teachers

I. GOVERNMENT AGENCIES AND ORGANIZATIONS

— National and State Government Agencies —

Michigan Department of Natural Resources
Information Services Center
P.O. Box 30028
Lansing, MI 48909

Ohio EPA
P.O. Box 1049, 1800 WaterMark Dr.
Columbus, Ohio 43266-0149
(614) 481-7000

Ohio Department of Natural Resources
Office of Public Information and Education
Fountain Square
Columbus, Ohio 43224
(614) 265-6789

Soil Conservation Service
U.S. Department of Agriculture, Ohio Office
200 N. High St., Room 522
Columbus, Ohio 43215
(614) 469-6962

U.S. EPA
Office of Public Affairs
Washington D.C. 20460
(202) 382-4361

U.S. EPA, Region V
(Ohio, Michigan, Indiana, Illinois, Wisconsin)
230 S. Dearborn
Chicago,IL 60604
(800) 621-8431

Washington Department of Ecology
Litter Control and Recycling Program
4350 150th Ave. NE
Redmond, Washington 98052
(206) 885-1900

— National Organizations with Expertise on Toxic Substances —

Center for Science in the Public Interest
1755 S Street, NW
Washington, D.C. 20009
(202) 332-9110

Citizen Action
225 W. Ohio Street, Suite 250
Chicago, IL 60610
(312) 645-6010

Citizens Clearinghouse for Hazardous Waste
Box 7097
Arlington, VA 22207
(703) 276-7070

Clean Water Action Project
733 15th Street, NW
Washington, D.C.
(202) 638-1196

Conference on Alternative State and Local Policies
2000 Florida Ave., NW
Washington D.C. 20009
(202) 387-7030

Environmental Action Foundation
724 DuPont Circle Building
Washington, D.C. 20036
(202) 659-9681

Environmental Defense Fund
1616 P Street, NW
Washington, D.C. 20036
(202) 387-3500

Environmentalists for Full Employment
1536 16th Street, NW
Washington, D.C. 20036
(202) 347-5590

Environmental Law Institute
1616 P Street, NW
Washington, D.C. 20036
(202) 328-5150

Environmental Policy Institute
317 Pennsylvania Avenue SE
Washington, D.C. 20003
(202) 547-5330

Health Research Group
2000 P Street, NW
Washington, D.C. 20036

National Coalition Against the Misuse of Pesticides
530 7th Street, SE
Washington, D.C. 20003
(202) 543-4312

National Science Teachers Association
1742 Connecticut Avenue, NW
Washington, D.C. 20009
(202) 328-5800

National Wildlife Federation
Educational Servicing
1412 Sixteenth Street, N.W.
Washington, D.C. 20036-2266
(202) 797-6842

Natural Resources Defense Council
1725 Eye Street, NW
Washington, D.C. 20006
(202) 223-8210

Sierra Club
530 Bush Street
San Francisco, CA 94108
(415) 981-8634

Trial Lawyers For Public Justice
2000 P Street, NW
Washington, D.C. 20036
(202) 463-8600

Urban Environment Conference
666 11th Street, NW
Washington, D.C. 20001
(202) 797-0446

—Names of state, county, and local agencies vary from area to area. This is a list of some common names to look for:

Department of Natural Resources
Department of Health
Public Utilities Commission
Environmental Protection Agency
State Fire Marshall
Agriculture Department
Industrial Commission
Office of Litter Control
Fire Department
Recreation and Parks Department
Refuse Collection Division
Poison Control Center
Disaster Services Agency
Water Utility

—In addition to government agencies, you might look for the following organizations and services at the local level:

Libraries
Museums
Nature Centers
Public Broadcasting Stations
Recycling Centers
School Media Centers
Universities

II. A FEW BOOKS FOR REFERENCE AND GENERAL READING

America The Poisoned, Lewis Regenstein. Acropolis Press, 1982.

Buried Treasure at Risk: A Strategy to Protect Ohio's Groundwater, Ohio Environmental Council, P.O. Box 2118, Columbus, Ohio 43216, 1986.

Citizens' Guide for Community Health Studies, State of Michigan, Toxic Substance Control Commission, P.O. Box 30026, Lansing, MI 48909, (517) 373-1031, 1985.

The Closing Circle, Barry Commoner. Alfred A. Knopf, Inc. 1971

The Dilema of Toxic Materials: Classroom-tested Ideas and Resources for Social Studies and Science Teachers. Gerald C. Llewellyn, Martin A. Tarter, and Marijean Hawthorne. School of Education, Virginia Commonwealth University, Richmond, VA 23284, 1985.

Groundwater Quality Protection in Oakland County: A Sourcebook For Teachers, East Michigan Environmental Action Council, One Northfield Plaza, Troy, Michigan 48098, 1984.

Hazardous Waste and the Consumer Connection, Michigan Environmental Education Association, Science for Citizens Center, Western Michigan University, 4360 Hagadorn Road, Okemos, MI 48864.

Hazardous Waste in America, Samuel Epstein, M.D., et al. Sierra Club Books, San Francisco, 1982.

Laying Waste: The Poisoning of America By Toxic Chemicals, Michael Brown. NY Pocket Books, Washington Square Press, 1981.

Michigan Household Hazardous Substance Handbook, Cooperative Extension Service and Ecology Center of Ann Arbor, 1986. 417 Detroit Street, Ann Arbor, MI 48104, (313)761-3186. $15.00.

The Politics of Cancer, Samuel Epstein, M.D. Anchor-Doubleday, Garden City, N.Y., 1979.

Pollution Prevention Pays, Michael G. Royston. Pergamon Press, 1979.

School Science Laboratories: A Guide to Some Hazardous Substances. Council of State Science Supervisors, U.S. Consumer Product Safety Commission, WAshington D.C. 20207, 1984.

A Season of Spoils, Jonathan Lash. Pantheon Books, 1984.

Silent Spring, Rachael Carson. Houghton-Mifflin Press, 1962.

SLEUTH: Educational Activities on the Disposal of Household Hazardous Waste, Municipality of Metropolitan Seattle, 821 Second Avenue, Seattle, WA 98104.

State of Ohio Groundwater Protection and Management Strategy, Ohio EPA, P.O. Box 1049, 1800 Watermark Drive, Columbus, Ohio 43266, 1986.

Toxics in My Home? You Bet!. Golden Empire Health Planning Center, 2100 21st Street, Sacremento, CA 95818.

The Toxic Substances Dilema: A Plan for Citizen Action, National Wildlife Federation, 1421 16th Street N.W., Washington D.C. 20036, 1980.

III. AUDIO VISUAL RESOURCES

Bill Smith's New Chemical - 23 min., color, 1979, free rental. Describes the need to balance the benefits and risks of synthetic chemicals. It contrasts sharply with "Serpent Fruits." If the Two films were used together they would make a full period presentation.

Modern Talking Pictures
5000 North Park Street
St. Petersburg, FL 33709 (813) 541-5763

Black Tide - 58 min., color, $65.00 rental, Nova Series, often repeated on PBS. Describes the devastation of the French Brittany Coast when the tanker, Amoco Cadiz wrecked. It develops the point that these types of disasters will continue to occur if international agreement on tanker standards are not reached.

Time/Life Video Distribution Center
P.O. Box 644
Paramus, NJ 07652 (201) 843-4545

The Chemical Balance - 12 min., color, 63 slides with audio cassette, $40.00 purchase. This set tells what the chemical industry is doing to minimize the risks and maximize the benefits of chemicals through research and initiative. Chemical industry orientation but interesting.

Chemical Manufacturers Association
Communications Department
2501 M Street, N.W.
Washington, D.C. 20037

The Cost of Cotton - 30 min., color, $50 - $75 rental. Looks at the effect of massive pesticide use on worker-family health in developing nations. A Spanish version is available also.

Solid Waste Information
EPA Cincinnati, OH 45368 (513) 648-6362

Dealing With Toxic Substances: A Citizen's Role - 15 min., slide/cassette, color, 1980, EPA produced. Explains how citizens can get involved in the effort to control this national problem. Explains also TSCA's authority and toxic laws. It has accompanying literature.

Urban Environment Conference
666 11th Street, N.W.
Washington, D.C. 20001 (202) 797-0446

Ground Water: the Hidden Reservoir - 19 min., color, 1971, $15 rental. The significance of ground water and the necessity for protection are discussed in the film. The hydrologic cycle and aquifers are illustrated.

BAVI
University of Wisconsin Extension
P.O. Box 2093
Madison WI 53701-2093 (608) 262-1644

Hazardous Waste Disposal - 20 min., color, 50 slide set, $40 purchase. This slide set was designed for classroom use and covers Love Canal, Valley of the Drums, the Brickyard in Kentucky, Elizabeth City in New Jersey, PCB spill in North Carolina and clean up operations. Examples of ground water contamination are pictured in several states. Disposal methods such as secure landfill, deep well unjection, incineration on land and at sea and chemical treatment are illustrated. This series seems quite suitable for the middle school science and social science classroom.

James L. Ruhle & Associates
P.O. Box 4301
Fullerton, CA 92634 (714) 526-6120

Hazardous Waste is Everybody's Problem: Get Involved - 20 min., Contains 140 slides with a cassette tape, free rental. Production funded by EPA. Presents a good overview of the whole problem of waste and hazardous waste.

National Association of Conservation Districts
1025 Vermont Avenue, NW Room 730
Washington, DC 20005 (202) 347-5995

Hazardous Waste Options - 24 min., color, EPA produced, free rental. Documents hazardous waste management operations. It includes recycling, waste treatment, landfilling, incineration, deepwell injection and land treatment.

Modern Talking Picture Service
5000 North Park Street St.
Petersburg, FL 33709 (813) 541-5763

Hazardous Waste: The Search for Solutions - 58 and 35 min., color, 3/4 inch video cassette or 16 mm film, $25 rental. It shows what people can do to help themselves and the results achieved. The program deals with the problem from an environmentalist point of view. It presents the right-to-know laws in CA, health surveys from OH and citizen lobbies in MA and PA. A very appropriate film made in 1981 that has been shown on PBS. Consider calling your local PBS station and requesting information about having it broadcast.

BAVI
University of Wisconsin Extension
P.O. Box 2093
Madison, WI 53701-2093 (608) 262-1644

In Our Own Backyard: The First Love Canal - 59 min., color, 3/4 inch videocassette, or 16 mm film, $45 rental. An overview of the Love Canal problem that concentrates on citizen action and procedures to achieve positive support. It illustrates the biological, economic, sociological and psychological problems encountered in such incidents. Quite emotional and better suited for the teacher, older and more mature students but could be used in upper level classes in middle school both in the sciences and social sciences.

Bullfrog Films, Inc.
Oley, PA 19547 (215) 779-8226

Introduction to Hazardous Materials - 28 min., color film. It emphasizes numerous and dramatic incidents in FL, TE, NY, CT, and other states. Dramatic footage of fires and poisonous gas transportation accidents are used to develop the approach to handling these incidents. It shows the fireman's responsibility at such incidents. Science students should enjoy the dramatic photography. Used in some fireman training programs.

Courtner Films Distributing Center
121 N.W. Crystal Street
Crystal River, FL 32629

The Killing Ground - 48 min., color, 1979, $70 rental or free from the VA Department of Health. A dramatic presentation of the effects of improper chemical waste dumping in Montague, MI, Shakopee, MN, Baton Rouge, LA and the Love Canal area of Niagara Falls, NY.

Virginia Department of Health
Bureau of Hazardous Waste Management
James Monroe Building, 101 N. 14th Street
Richmond, VA 23219 (804) 225-2698

ABC Learning Resources
1330 Avenue of the Americas
New York, NY 10019

More Than A Paycheck - 28 min., color, $25 rental. Workers in certain industries are contaminated with chemicals that may cause cancer or other health problems. The film recommends solutions.

National Audio Visual Center
Government Services Administration
Att: Order Section RR
Washington, DC 20409

The Need To Know - 28 min., color, film or videotape, free rental or purchase from CMA below. A fairly unbiased film produced by the chemical industry that presents an overall view of the toxic waste problem. It discusses orphan sites and emphasizes their threat. Many solutions to the disposal problems are presented.

Modern Talking Picture Service
5000 Park Street North
St. Petersburg, FL 33709 (813) 541-5763

Chemical Manufacturers Association
Att: Communications Dept.
2501 M Street, N.W.
Washington, DC 20037 (202) 887-1100

Our Hidden National Product - 25 min., color film, 1979, $45 rental. It is concerned with determining the location of a hazardous waste disposal site and the problems associated with this procedure. Alternative solutions are discussed.

Durrin Films, Inc.
4926 Sedgwick Street, N.W.
Washington, DC 20016

The Rise and Fall of DDT - 18 min., color film, $25 rental. The controversy around DDT is explored. The pesticide was considered a miracle substance when it was first developed, but now it is banned in the USA.

Time/Life Multimedia
Time & Life Building, Room 32-48
New York, NY 10020

Serpent Fruits - 30 and 60 min. versions, color, free rental.
Covers the case histories of the synthetic chemicals, 2, 4, 5-T, DES and PBB. Labor, industry and government views are presented.

Lifelong Learning Films
University of California Extension
Media Center
Berkeley, CA 94720

Song of the Canary - 58 min., color, 1979, $70 rental. Part one documents the national scandal that arose when workers found out that they were sterile from pesticide DBCP. Part two discusses brown lung and related problems in the Carolinas.

New Day Films
P.O. Box 315
Franklin Lkes, NJ 07417

Appendix C.

GLOSSARY

Absorption Field - the second phase of a septic system. Here the treated waste water is filtered through a series of pipes and gravel.

Acid - a chemical compound, usually with a sour taste, which has a pH less than 7 when dissolved in water.

Acute Reaction - an immediate illness or effect resulting from a brief exposure to a toxic substance.

Aerobic Decomposition - a decomposition process with bacteria utilizing oxygen. Anaerobic decomposition occurs without oxygen.

Alkaline - see base.

Aquifer - underground water stored in porous rock formations.

Artesian well - a well in which water naturally rises above the aquifer.

Asbestos - a mineral with long, thin fibers. Used for brake linings, fireproofing, insulation and sound-deadening between 1940 and 1979.

Base - or alkaline is a chemical compound, which tends to be salty and has a pH greater than 7 when dissolved in water.

Bedrock - the solid parent rock beneath soil and looser rock.

Biocide - any chemical that kills living organisms.

By-product - a substance which is created as a result of making or doing something else; not the main product.

Cancer - a change in the normal growth of cells. Several genetic diseases are classified as cancerous.

Carcinogen - a substance which produces cancer.

Caution - on product labels, a signal of a very slightly toxic substance with a lethal dose for a 150 lbs. person of more than two (2)quarts.

CERCLA - Comprehensive Environmental Response, Compensation and Liability Act of 1980. See Superfund.

Chronic reaction - an illness or effect which is the result of repeated or long-term exposure to a toxic substance.

Contaminate/Contamination - to pollute or make impure.

Corrosive wastes - a chemical that causes a visable destruction of skin, metal or other materials.

Danger - on product labels, a signal of a very toxic substance with a lethal dose for 150 lbs. person of two (2) drops - 2 tablespoons.

DDT - an organic chemical compound insecticide; hydrocarbon. (Diclora-diphenyl-trichlorethane).

Drainage basin - the total area that contributes water to a stream or lake; a watershed.

Effluent - flowing waste material such as smoke, liquid, or sewage.

Element - a substance which cannot be decomposed into simpler substances by chemical reactions. There are 92 naturally occurring elements.

Environment - all the conditions and influences surrounding and affecting an organism or group of organisms.

Erosion - the wearing away of soil by wind and water.

Fauna - animals.

Fertilizer - an organic or chemical mixture put on the soil to increase plant productivity.

Flora - plants.

Food Chain — a series of organisms dependent upon one another for food (e.g. grass-rabbit-hawk).

Generator - a person or industry who produces something (in this case usually referring to hazardous waste).

Geology - the science of earth's processes.

Groundwater - all the water which flows and seeps within the bedrock and under the surface of the ground.

Hazardous Material/Substance - a chemical which has the potential of being toxic, ignitable, corrosive, or reactive if improperly stored, used or disposed.

Hazardous Waste - a hazardous material which has been spilled or thrown away. RCRA definition: "solid or liquid waste that may cause or significantly contribute to serious illness or death, or that poses a substantial threat to human health or the environment when improperly managed." The term "solid" includes waste which can be the consistancy of honey.

Herbicide - an agent used to kill or inhibit plant growth.

Hydrological Cycle - the process of evaporation, precipitation, and flow of the earth's water.

Ignitable Wastes - wastes which may ignite in the presence of a spark, friction, or water.

Impermeable - a substance which does not allow liquid to pass through it.

Incineration - process of burning waste at very high temperatures, often liquid.

Infectious Wastes - wastes which may transmit diseases to animals.

Ingestion - the eating or drinking of a substance.

Inhalation - the breathing of vapors, gases, mists, aerosols, fumes and/or dust.

Irritant - a chemical which causes a reversible inflammatory effect on living tissue (like a skin rash or reddening).

Kommunichem - Denmark's national hazardous waste disposal facility.

Landfill - large pits where waste is dumped and buried. The bottom is usually lined with clay and/or heavy plastic to reduce the chance of contaminated water leaking into the groundwater.

Leaching - the seeping of water which may be contaminated with chemicals through the soil or other materials.

Lethal Dose - the amount of a substance which is capable of causing death. LD/50 = that amount which kills 50% of the test population.

Leukemia - a cancerous disease characterized by an uncontrolled and abnormal development of white blood cells.

Love Canal - an area in a suburb of Niagara Falls, NY where 20,000 tons of chemical wastes were dumped between 1942 and 1953.

Manifest System - a document which tracks the hazardous waste from its generator to its final storage or disposal.

MSDS - Material Safety Data Sheet, as required by OSHA. It gives health and safety information on individual hazardous chemicals.

Mutagen - a chemical which causes changes in genetic material (DNA).

Organic Compound - materials whose basic units are carbons. They are formed through a chemical reaction under heat or pressure (i.e. DDT, PCB, dioxin, etc.).

PCB - Polychlorinated Biphenyl - a toxic, oily synthetic hydrocarbon compound widely used in insulating and cooling liquids.

Permeability - capacity for transmitting fluids.

Pesticide - an agent that kills pests (insects, fungi, rodents, etc.)

Petrochemicals - a chemical derived from petroleum or natural gas. (These include plastics, rubber, nylon, etc.).

Pits, Ponds, Lagoons - shallow surface holding ponds for liquid hazardous waste.

Pollutant - any waste substance put into a natural system in greater amount than can be neutralized by the system.

Polyethylene Liner - heavy-duty plastic often used for lining landfills.

Producer of Hazardous Waste - an individual, institution or industry which creates hazardous waste in the use, production or disposal of chemicals.

Radioactive Waste - wastes that emit radiation which may cause genetic damage, cancer or death. May come from nuclear power plants, hospitals, laboratories and weapons factories.

RCRA - Resource Conservation and Recovery Act is a law passed in 1976 which manages the nation's solid wastes (including hazardous waste).

RCRA Site - an approved hazardous waste management facility.

Reactive Wastes - chemically unstable wastes which can explode or release highly toxic gases when exposed to heat, water, pressure or other wastes.

Recharge/Regeneration - when an aquifer receives water through the soil or more direct source (like rain) which replenishes its supply of water.

Recycling of Waste - using a waste product as a raw or secondary material in product manufacture.

Reuse of Waste using waste over again, often after some processing to clean or separate its components.

Runoff - water that flows over land.

Salt Dome - a mass of salt rock underground where wastes can possibly be stored.

Sediment - loose particles of materials suspended in or deposited by wind, water or ice.

Sludge - a soft, thick, muddy mixture of sediments.

Solvent - a liquid which dissolves another substance without a chemical change in either.

Spring - a natural upwelling of water flowing from the earth.

Superfund - (CERCLA) this law gives EPA broad authority to regulate releases of hazardous substances to the environment.

Synthetic Organics - materials manufactured from coal, natural gas or petroleum.

Systemic Injury - effecting a body system or organs after a chemical has been absorbed into the blood stream.

Teratogen - a chemical that causes birth defects.

Threshold Limit Value - (TLV) the concentration of a chemical in air to which workers can be exposed for 40 hours per week without experiencing acute adverse effects.

Toxic Substance - a chemical that harms or kills plants/animals by poisoning them.

Toxic Wastes - a category of hazardous waste which can produce acute or chronic health damage. They can be organic, inorganic, or synthetic organic chemicals.

Toxicity - the ability of a chemical substance to produce harm or injury to a living organism when the chemical has reached a certain concentration at a particular exposure.

U.S. E.P.A.- United States Environmental Protection Agency. Federal coordinator of environmental regulations.

Warning - on product labels, a signal of a slightly to moderately toxic substance with a lethal dose for a 150 lbs. person of two (2) tablespoons to 2 quarts.

Water Cycle - see hydrologic cycle.

Watershed - see drainage basin.

Water Table - the upper limit of the portion of the ground saturated with water.